

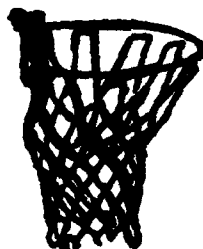
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PLAY BALL!

TOWARD BETTER MANAGEMENT

Captain Donald E. Walters, USAF



Research shows there are many factors relating to on-the-job behavior exhibited by managers (manner in which they carry out managerial duties on a day-to-day basis). These factors include, but are not limited to, things like education, experience, age, sex, personality, individual values, and a specific situation facing the manager.^{1,2}

Participating in sports also is believed to be a factor. It is generally believed that participating in sports has direct impact on developing leadership abilities and interpersonal skills.³ The military services promote sports participation by providing opportunities and facilities for many athletic activities; i.e., intramural programs, gymnasiums, swimming pools, tennis courts, areas for running, and organized sports programs for dependents. Official policy at the United States Air Force Academy is based on the philosophy that "athletics are significantly related to leadership and, thus, constitute a major contribution toward the accomplishment of the USAF Academy mission."⁴

On a more general level, in 1981, the Physical Education Public Information project formulated five concepts on physical education for elementary and secondary-level school children. Two concepts were "a sound physical education program contributes to development of a positive self-concept," and "a sound physical education program helps an individual attain social skills."⁵

Whether or not sports participation is related to managerial behavior remains to be seen. However, research provides evidence to support the claim that managers who participate(d) in sports are expected to perform better on the job than non-participating counterparts. In a study by Robert Half International Associates, an executive recruiting firm, it was determined that of 180 executives from 12 different companies earning from \$30,000 to \$50,000 annually, those listing sports participation on resumes earned an additional \$3,120 (on the average) annually. The reason given was that employers felt those playing sports had more potential.⁶

Research Study

This article summarizes results of a research study examining the popular, but empirically untested, notion that participation in organized sports might be an influencing factor on managerial development; more specifically, on managerial development of U. S. Air Force acquisition pro-

ject officers who are program/project managers (hereafter referred to as program managers) working within a system program office.⁷

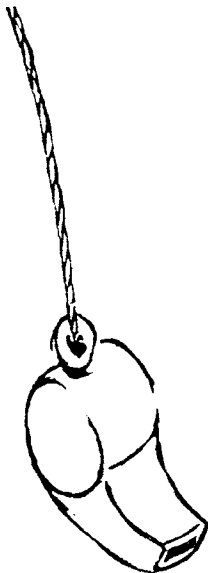
Exploration of this hypothesized relationship was performed within the context of Air Force program managers assigned to the Aeronautical Systems Division, Wright-Patterson Air Force Base, during spring/summer 1986. The methodology compared managerial behavior: between program managers participating in organized sports (team and individual) vs. those participating in few or no sports; and between those participating in different team sports. This was accomplished by determining mean scores in each of six managerial roles for 34 Aeronautical Systems Division program managers. These mean scores represented overall managerial performance as reported by each manager, and also by up to three more evaluators professionally related to that manager.

Statistically significant differences were found in mean scores between managers participating extensively in sports vs. those participating less; between those concentrating in team sports vs. those concentrating on individual sports; and between those participating in different team sports. In addition, the total number of years of sports participation was found, using regression analysis, to be linearly related to the mean scores for all six roles (See Figure 1).

Positive Results

Results clearly indicated a positive relationship existing between participating in sports and managerial behavior—within confines of Aeronautical Systems Division program managers. In the context of this study, Air Force system program offices are assumed to be matrix organizations—the dominant form of organization for most Air Force program offices.

The key to making the research effort work was being able to identify instruments for measuring managerial behavior and sports participation; a sports model resembling the matrix organization; and, being able to tie it together to test the derived hypotheses. Following is a discussion of managerial-behavior concepts, type of managerial behavior required for successful management within a matrix organization, Robert Keidel's sports model, and how these concepts form the basis of the hypotheses investigated in this study.



**FIGURE 1. MORSE AND WAGNER'S
SIX MANAGERIAL BEHAVIOR ROLES**

ROLE 1:	MANAGING THE ORGANIZATION'S ENVIRONMENT AND ITS RESOURCES Responsible for managing the organization's environment and outside settings through the allocation of scarce organizational resources.
ROLE 2:	ORGANIZING AND COORDINATING Responsible for organizing the separate and distinct tasks within their organizational unit and coordinating those diverse tasks through appropriate collaboration and cooperation toward the accomplishment of overall organizational goals.
ROLE 3:	INFORMATION HANDLING Responsible for the information and communication flows both within his/her organizational unit and between the unit and its external environment.
ROLE 4:	PROVIDING FOR GROWTH AND DEVELOPMENT Responsible for providing for their own personal growth and development and the personal growth and development of associates.
ROLE 5:	MOTIVATION AND CONFLICT HANDLING Responsible for effective motivating of organizational members toward the accomplishment of organizational goals and handling disturbances and conflicts that may be detrimental to the energizing and motivating of associates.
ROLE 6:	STRATEGIC PROBLEM-SOLVING Responsible for the effectiveness of their own decision-making and problem-solving processes and ensuring that associates are effectively utilizing their own problem-solving skills.

Research indicates a manager's job can be studied from at least three perspectives, which are managerial functions, managerial skills and managerial roles. The first two are basically the foundation of what managers do and skills used; functions like planning, organizing, leading and controlling; and skills like technical, people, conceptual and diagnostic.

Successful Managers Adapt

The third perspective on the manager's job is the set of behaviors or roles required, utilizing acquired skills, to perform managerial functions. The role for a manager is the capacity in which he or she acts. For example, a manager may act as a leader of subordinates, a spokesperson of the organization, source of information, or one who makes decisions. Simply put, successful managers must constantly adapt to changes, react to crises, and be able to "play different roles" while performing their jobs.⁸

How managers behave, while functioning in these roles, is primarily a function of interpersonal skills. Research suggests that the more developed the interpersonal skills, the more effective the manager should be.^{9,10} This relationship then suggests that interpersonal skills managers possess are key factors in determining their managerial performance. Therefore, measuring performance of managers, by evaluating their behavior while carrying out different managerial roles, should provide insight into the degree of interpersonal skills.

John J. Morse of the Florida International University, and Francis R. Wagner of Loyola Marymount University developed an instrument to measure and evaluate managerial behavior, the Evaluating Managerial Performance Survey (EMPS). Previously validated and in use since 1976, it consists of a set of six managerial roles: (1) managing the

organization's environment and its resources; (2) organizing and coordinating; (3) information handling; (4) providing for growth and development; (5) motivation and conflict handling; and (6) strategic problem-solving.¹¹ A description of effective managerial behavior required for each role is provided in Figure 1.

Research shows there is no single all-purpose style or behavior. Successful managers can adapt their behavior to meet demands of their unique situation.¹²

Unique Situations

Unique situations program managers are faced with in the SPO (matrix management) environment are constant conflict, vagueness and ambiguity.¹³ This is due primarily to the nature of the matrix, where the program manager is required to manage programs and people in uncertain and chaotic conditions, with little or no

authority of the functional staff. Successful matrix management, therefore, requires a management behavior to resolve conflict and cope within a vague environment.¹⁴

This implies that the program manager, besides being technically competent, must be a team player with necessary managerial (specifically interpersonal) skills to motivate others to achieve organizational objectives.

From a managerial behavior perspective, Morse and Wagner suggested:

...that managers in industries and organizations coping with rapidly changing, uncertain, external environments and markets would pay special attention to 'controlling the organization's environment and its resources' and 'information handling,' while managers in stable, certain environments and markets would be somewhat less concerned with that behavior and concerned with 'strategic problem solving' behavior.¹⁵

They determined that the more the managerial position requires working through and with people in the organization, the more a manager in that position might have to attend to motivation and conflict handling activities regardless of organization.

Interpersonal Skills

This implies that "motivation and conflict handling, information handling," and "controlling the organization's environment and its resources" are roles requiring a high degree of interpersonal skills. If the position that participation in sports influences development of interpersonal skills is valid, the more a program manager has participated in an "interpersonal skills developing" sport, the more effective he should be at "motivation and conflict handling, information handling," and "controlling the organization's environment and its resources" activities.

The idea that participation in sports influences development of interpersonal skills is directly related to Robert Keidel's concept of sports as models for organizations. Keidel suggests that structure and management of the three major professional sports—baseball, football, basketball—provide analogies to serve as guides in analyzing organizations and people within them.¹⁶

Professional team sports are a fertile laboratory for managers, Keidel adds, because they mirror business. At a basic level, they concern the need to compete externally, the need to cooperate internally, the need to manage human resources strategically, and generic structure.¹⁷ In its simplest form: Football represents control; baseball represents autonomy; basketball represents voluntary cooperation.

Each model is grounded in a particular kind of internal 'interdependence.' This idea has to do with how parts (or members) of an organization interact. In *pooled interdependence*, there is little or no interaction; the parts act more or less independently of each other. In *sequential interdependence*, the parts interact in series: A feeds B, which in turn feeds C, and so on. In *reciprocal interdependence*, each part interacts with every other. The flow is back-and-forth.¹⁸

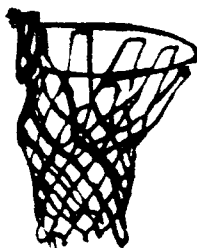
Each sport contains examples of every form of interdependence. The difference between each model is due to the degree of task-based interaction among unit members. The degree of this interaction is low for pooled relationship, moderate for sequential, and high for reciprocal.¹⁹

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BASEBALL MODEL. Of the three sports, professional baseball exhibits the greatest degree of pooled interdependence (PI). Team-member contributions are relatively independent of each other. Rarely are more than a few players on the field involved directly in a given play. The geographical dispersion of the players are the least dense of the three sports. The basic unit is the team, and overall performance approximates the sum of team members' performances. Other examples of team sports exhibiting this type of interdependence are softball, track, swimming and bowling.

As a model for business, baseball-like organizations are loosely fitted and include groups like the classic sales organization comprising high-performing soloists, and aggregations of basic researchers where each independently pursues a line of inquiry.

Keidel suggests organizations resembling a baseball team should probably concentrate on technical and individual criteria in assessing prospective, or evaluating current employees. Therefore, the successful manager in this type of organization probably should place more emphasis on the role of "providing for growth and development."²⁰



FOOTBALL MODEL. A high degree of sequential interdependence (SI) is exhibited in professional football. Dispersion of the players is denser than in baseball. All players on the field are involved in every play—football is “tightly coupled.” There is a continuous element of contingency about who controls the ball. Offense and defense can reverse roles at any time because of a turnover (fumble or interception), although normal transitions are often played by specialists on the “special teams.” The basic unit comprises large groups of offense, defense, and special teams and, to a lesser degree, the small group including linemen, linebackers and backfield. Overall performance is basically the sum of the groups’ performances.

Organizations within the football model tend to have “long-linked” technologies—their production processes involve complex, discrete steps that are tightly coupled in serial, sometimes parallel, order. The most obvious example is the mass-production assembly line. Other examples include vertically integrated firms and large construction firms like power plants, ships, high-rise buildings, etc. Always, effective performance depends on the ability to orchestrate a complicated but predictable set of activities in careful sequence.²¹ Therefore, the managerial role managers in football-type organizations should be most concerned with is “strategic problem-solving” behavior.

BASKETBALL MODEL. Professional basketball exhibits a high degree of reciprocal interdependence (RI), as demonstrated by the back-and-forth flow of the ball among players. Dispersion of basketball players is the most dense of the three sports; they are tightly coupled to all teammates in a fluid and unfolding manner. Where offense and defense are “linked” in football, they are overlapping or “intersecting” in basketball. The transition game, unlike football, is continuous, part of the flow. The basic unit is the team. Team performance, therefore, is a function of player interaction, where each player may be involved with every player on the court. Examples of other sports falling into this category are volleyball, hockey, rugby and water polo.

The basketball model can be equated easily to a matrix organization through its spontaneous interactions, mutual adjustments and voluntary cooperation of players. Keidel elaborates on this: “Organizations of this sort are tightly coupled but less than tightly hierarchical. They depend more on member interaction than on managerial direction.” An analogue within more conventional organizations, Keidel suggests, is the *ad hoc* task force that cuts across levels and functions, and in which all members interact in virtually all aspects of problem-solving activity. They are self organizing and highly flexible, he adds.²²

Training Grounds

Keidel’s sports model illustrates how different types of sports can be seen as training grounds for similarly structured organizations. This would suggest that the degree of “interpersonal skill” training should be a function of the specific types of sports with which the participant was/is associated.

Participation in team sports with much reciprocal interdependence (basketball model) should produce the highest degree of task-based interaction among unit members which, in turn, should lead to the highest degree of “interpersonal skill” training. The degree of reciprocal interdependence decreases as one goes through the remaining types of sports.

Team sports with much sequential interdependence (football) are next, followed by those with much pooled interdependence (baseball) and, finally, individual sports in general. This relationship would suggest that the degree of “interpersonal skill” training should decrease as one goes through these four different sports.

Based on objectives of the research effort and findings identified in the previous discussion, the following hypotheses were posited:

- H₁: The managerial behavior of program managers who have played sports will be rated significantly higher than the ratings of program managers who have played less or no sports at all.
- H₂: Of those program managers who have played sports, the managerial behavior of those who have concentrated more on team sports will be rated significantly higher than the ratings of those who have concentrated more on individual sports.
- H₃: Of those program managers who have played team sports, the managerial behavior of those who have concentrated more on sports with high degrees of *reciprocal interdependence* will be rated significantly higher than the ratings of those who have concentrated more on sports with high degrees of *pooled interdependence* or *sequential interdependence*.

Athletic prowess was investigated as an additional aspect of sports participation and formulated as a fourth hypothesis. Findings will not, however, be reported here due to redundancy in test results.

The research population of interest was considered to be all United States Air Force program managers in the Air Force Systems Command assigned to Aeronautical Systems Division (ASD). The population was restricted to ASD due to time constraints associated with administering surveys and receiving timely responses.

A complete listing of all program managers assigned to ASD as of May 12, 1986, was obtained from the personnel office. From this list, the size and the individuals within the population of interest were identified. The size of the population was 441 individuals.

Sampling Techniques

A combination of sampling techniques was used to obtain the selected sample of program managers. Initially, a list of 25 supervisors and coworkers of program managers within ASD were shown the listing of program managers obtained from ASD personnel. They were then asked to identify program managers that they considered to be effective managers and, in a separate group, those managers they considered to be less effective. From this, a sample of 75 program managers, representing 21 out of the 29 organizations within ASD, were obtained. This technique was used to ensure that the sample would contain a sufficient number of effective and less-effective managers and, thereby, avoid a concentration of extremes. In addition to the 75 officers sampled, three evaluators per manager were selected for a total of 300 respondents. The three evaluators were the manager's supervisor and two of his subordinates or program team members. Selection of the two non-supervisor evaluators was accomplished using two different methods. For the initial 50 program managers, evaluators were randomly selected by me. For the remaining 25, the evaluators were randomly selected by the managers themselves.

Two survey instruments were used to collect data to evaluate the research hypotheses. The primary survey, which was completed by individual managers, was divided into three parts. Part I was a modification to the Evaluating Managerial Performance Survey designed by Morse and Wagner.

The questionnaire measured managers' perceptions of their on-the-job behavior for each of the six previously identified managerial behavioral roles (see Figure 1). Each role was characterized by a series of statements relating specific behavior to one of the six specific roles. Roles 1 and 2 comprised 11 and 13 statements, respectively. Roles 3 and 4 contained 7 and 8 statements, and Roles 5 and 6 contained 7 and 5—a total of 51 statements.

Part II, used to obtain demographic information on managers' sports-participation backgrounds, asked managers to answer questions about sports participation experience. Questions related to things like specific sports they had or were participating in, and the amount of participation. Finally, Part III was a demographic data sheet to obtain general information on managers' professional backgrounds.

Supplemental Survey

The supplemental survey completed by the additional evaluators was divided into two parts. Part I was a further modification to the Evaluating Managerial Performance Survey. The questionnaire measured the evaluator's perception of the manager's on-the-job behavior. Its structure and content were basically the same as the questionnaire completed by program managers except that statements were proposed from a different perspective. Part II was used to determine the professional relationship between the manager being evaluated and the evaluator.

The survey asked for anonymous responses from the sampled individuals. If the respondents had comments, they were asked to write them in the booklet.

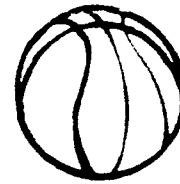
The 51-statement, 6-role Evaluating Managerial Performance Survey was factor-analyzed using a correlation matrix obtained from a sample of 406 managers surveyed by Morse and Wagner. Validity of the instrument was established based on factor interpretation of the six behavioral roles. Internal consistency of the managerial-effectiveness scale was partially demonstrated from the intercorrelations of the six factors (roles). Further evidence of reliability resulted from computing a Kuder-Richardson coefficient for the data from the sample used in developing the factor analysis in ($n = 406$). The obtained reliability was .91. Finally, an adequate test-retest coefficient of .78 during a 6-week period was obtained from the sample of 29 managers in the headquarters of a large manufacturing firm.²³

For the Evaluating Managerial Performance Survey portion of the two surveys, a nine-point rating scale ranging from +4 (the statement is unqualifiedly representative of the manager's behavior) to -4 (the statement unqualifiedly does not represent the manager's behavior) was used on each of the 51 statements in the six different categories. Arithmetic means of the responses were determined for each category (role). The mean responses of each manager were combined with those of the three additional evaluators for overall mean scores for each of the six roles.

Mean Scores

Once overall mean scores were computed for each manager, different groupings (depending on their sports participation backgrounds) were determined and group means were computed and compared to each other to determine which groups of individuals scored higher. Mean scores were also used as dependent variables in the regression analysis.

Utilizing demographic data obtained from surveys, managers were placed into different groupings identified in the hypotheses. Type of sports played, number of years of participation, and frequencies of responses were used to determine configuration of groupings.



Group means were obtained and simple t-test (computation of test statistics) were performed to compare the differences between means. Those groups with significantly higher mean scores were considered the higher performers. Additionally, regression analysis was also performed on the first hypothesis.

From the selected sample of 75 program managers and the 225 additional individual evaluators, 34 individual cases, which included 34 program managers and 62 additional evaluators, were used in the data analysis (each program manager was evaluated by at least one additional rater). In addition, the 62 additional evaluators were 21 supervisors and 41 program team members.

The three hypotheses dealt with the type and amount of sports participation and were placed in their particular sequence to provide a stepping-stone analysis of the model. In other words, each hypothesis was built on the previous one, and served as a foundation on which to develop the next one.

Decision Criteria

The decision criteria used for accepting or rejecting the null hypothesis (H_0), that there are no significant differences between the means of the different groups, was based on an alpha value of .05. This equates to the probability of rejecting H_0 , when H_0 is true, being less than or equal to 5 percent. Therefore, whenever the computed probability value (P-value) for each test was greater than .05, H_0 was not rejected. For P-values less than or equal to .05, H_0 was rejected and the claim that there is a significant difference between the population means was substantiated.

Because managerial behavior being evaluated consisted of six different managerial roles, there were, in effect, six subhypotheses tested for each major hypothesis. For the T-test evaluating the differences between group means, each subhypothesis

represented a specific managerial behavior (based on one of six specific roles) in terms of the comparison that was made. A generic listing of each subhypothesis is as follows:

- H_{n1} = For "managing the organization's environment and its resources" behavior, program managers in group one will have significantly higher ratings than will managers in group two.
- H_{n2} = For "organizing and coordinating" behavior, program managers in group one will have significantly higher ratings than will managers in group two.
- H_{n3} = For "information handling" behavior, program managers in group one will have significantly higher ratings than will managers in group two.
- H_{n4} = For "providing for growth and development" behavior, program managers in group one will have significantly higher ratings than will managers in group two.
- H_{n5} = For "motivation and conflict handling" behavior, program managers in group one will have significantly higher ratings than will managers in group two.
- H_{n6} = For "strategic problem-solving" behavior, program managers in group one will have significantly higher ratings than will managers in group two.

(n represents the number associated with each of the three main hypothesis). For the regression analysis, each subhypothesis represented a specific managerial behavior as dependent variable to be regressed against. Each subhypothesis is based on its respective behavioral role listed in Figure 1.

Hypothesis One

For the first hypothesis, exploratory nature of this research required that an initial, arbitrary determination be made regarding what constituted a sufficient amount of sports play to be considered in the first group. If program managers played a single organized sport for at least 7 years, 2 different organized sports for at least 5 years each, or 3 different organized sports for at least 3 years each, they were considered in the first group. Those not meeting this criteria were placed in group two, the "less or no sports at all" group.

Group one consisted of 22 program managers, and group number two of the remaining 12 (all 34 managers had some sports experience). Test statistics (T-test) were calculated to compare differences between the mean scores of the two groups for each of the 6 managerial behavior roles identified in Figure 1. The mean scores for all 6 roles were higher in the first group than in the second group. Additionally, for an alpha set at 0.05, all roles, except for Role 4 (providing for growth and development), were significantly higher.

A second T-test was also performed for this hypothesis, allowing data to be divided differently to see if results were consistent with the first test. Criteria to decide which individual would be in which group was determined by the median value of the total number of years each program manager had participated in for up to four different organized sports. If a manager had participated in more than one sport during the same time period, the concurrent number of years were added together. For example, if a manager played basketball the same 4 years he was playing tennis, his total participation for the two sports was 8 years. It was determined that for the 34 managers, the total number of years ranged from 1 to 28, with a median



value of 8. Therefore, using the median value as the criteria for determining the composition of the two groups, program managers having 9 or more years of total sports play were considered in the first group. Those having 8 or less years of total sports play were placed in group two—the “less or no sports at all” group.

Group one had 17 program managers and group two the remaining 17. Test statistics for each group were calculated to compare differences between mean scores of the two groups. This test resulted in the same statistical findings as did the first test. The indication was that for every role, except Role 4, the mean managerial scores were significantly higher for program managers participating extensively in athletics (group one) compared to those participating less (group two).

Regression analysis was also used to evaluate this hypothesis. The total number of years of sports play, computed for the second T-test, was used as the independent variable. This variable was then regressed against each of the six managerial behavior roles (the dependent variables). The significant T- or P-values for all six regressions were less than alpha of .05. This implies that $H_0: B_1 = 0$ is not true and that a significant positive linear relationship exists between the number of years played and the mean behavior scores for all 6 roles.

The computed R values, which measure the degree of linear relationships,²⁴ indicated a weak (for Roles 2 and 4) to moderate (for Roles 1, 3, 5 and 6) correlation between variables. The R^2 values, which describe how much of the sample variation in the dependent variables can be explained by variation in the independent variable, provided little (for Role 4) to a moderate amount (for remaining roles) of explanatory power to the models.

Hypothesis Two

For the second hypothesis, like the first one, an arbitrary determination was made regarding what constituted concentration in team sports vs. concentration in individual sports. If program managers played 1 team sport for at least 3 years, or 2 team sports for at least 2 years each, they were considered in the first group. Those playing less team sports and those concentrating on individual sports were placed in group two—“concentrated more on individual sports.”

Group one had 24 program managers and group number two had the remaining 10. Because all 34 managers were shown to have some sports experience, all 34 were considered in this analysis. Test statistics were calculated to compare differences between the mean scores of the two groups for each of the 6 managerial behavior roles. The mean scores for all 6 roles were higher in the first group than they were in the second. However, at a 0.05 level of significance, only Role 2 (organizing and coordinating) and Role 5 (motivation and conflict handling) were significantly higher. This implies managers having concentrated more on team sports were rated significantly higher than those concentrating more on individual sports in Roles 2 and 5.

Hypothesis Three

For the third hypothesis, again, an arbitrary determination was made regarding what constituted concentration within the different team sports. If program managers played 1 team sport with a high degree of reciprocal interdependence for at least 3 years or 2 team sports with a high degree of reciprocal interdependence for at least 2 years each, they were considered in the first group. Of remaining managers concentrating on team sports, those who played one team sport with a high degree of sequential interdependence

for at least 3 years or 2 team sports with high degrees of sequential interdependence for at least 2 years each were associated with the second group. Remaining team sport players were placed in the group three—“concentration on sports with high degrees of PI.”

Group one had 13 program managers, group two had 4, and group three had 7. Because sample sizes were small for groups two and three, it was decided to combine them into a single group of program managers concentrating on sports with either a high degree of sequential interdependence or a high degree of pooled interdependence. Groupings for this hypothesis were redetermined to be 13 program managers in group one and 11 in group two—“concentration on sports with high degrees of SI or PI.” In keeping with the “stepping-stone” approach, the 24 program managers identified for this hypothesis were the same managers identified as concentrating more on team sports in the previous hypothesis.

The mean scores for all 6 roles were higher in the first group than they were in the second. Additionally, for an alpha set at 0.05, all roles, except Roles 2 and 4, were significantly higher. Implication of these results were that managers concentrating on team sports with high degrees of reciprocal interdependence had significantly outperformed, in all but Roles 2 and 4, managers concentrating more on sports with either a high degree of sequential interdependence or pooled interdependence.

A summary of significant differences between the group means for 24 T-test (four sets of six subhypotheses) is provided in Table 1.



TABLE 1. SUMMARIZATION OF THE T-TEST

HYPOTHESIS	MANAGERIAL BEHAVIOR					
	1	2	3	4	5	6
H ₁ : Managers who have played more sports will have higher mean scores than will those who have played less.	S	S	S	N	S	S
	S	S	S	N	S	S
H ₂ : Managers who have concentrated more on team sports will have higher mean scores than will those who have concentrated more on individual sports.	N	S	N	N	S	N
H ₃ : Within team sports, managers who have concentrated more on RI sports will have higher mean scores than will those who have concentrated on either PI or SI sports.	S	N	S	N	S	S

S = Significant differences in mean scores at alpha of 0.05

N = No significant differences at alpha of 0.05

NOTE: H₁ was evaluated using 2 sets of T-test
H₂ and H₃ were evaluated using 1 set of T-test each
RI refers to those sports with high degrees of reciprocal interdependence.
PI refers to those sports with high degrees of pooled interdependence.
SI refers to those sports with high degrees of sequential interdependence.

Two Specific Conclusions

The overall outcome of all tests performed tends to support the position that participation in sports *does* have some effect on managerial performance of Air Force program managers. Two specific conclusions can be reached.

First, for every test performed, role 5 (motivation and conflict handling), requiring the highest degree of interpersonal skills, had the highest mean scores and provided the strongest relationship in all three hypotheses. This implies program managers participating heavily in sports in general, and high degrees of reciprocal interdependence sports specifically tended to outperform counterparts in this role by a greater margin than in the other 5 roles.

The implication of role 5 providing the strongest relationship supports the basic crux of this research effort. If participation in sports, in general, can be viewed as a training ground for developing interpersonal skills, and if the degree of "interpersonal skills" training can be viewed as a function of the specific types of sports the participant is associated with specifically, you would expect interpersonal skill development to increase from participating in sports in general to participation in sports with the highest amount of reciprocal interdependence.

Weakest Relationship

The second conclusion is that, regardless of sports background, for every test performed Role 4 (providing for growth and development) resulted in the weakest relationship in all three hypotheses. For every T-test performed, there were no significant differences between the mean scores for

any groupings in this role; the reason, perhaps, is due to the nature of the matrix organizational structure. In a matrix, where program managers have little or no authority of functional staff, they would be less concerned about professional growth of other professionals than would a more functional manager with "pure" subordinates working for him.

This research does not claim that participating in sports is undeniably a major influencing factor on managerial behavior. The research does assert that a relationship does appear to exist statistically. With this in mind, the observed outcome of this study tends to support the position that participation in sports in general, and sports with high degrees of reciprocal interdependence specifically, may provide excellent training grounds for developing necessary interpersonal skills required by successful managers.



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STRATEGIC DEFENSE COMMAND

The U.S. Army Strategic Defense Command has awarded short-term contracts valued at more than \$4.6 million to 15 defense and aerospace contractors for studying innovative approaches to midcourse interceptor technology for the Strategic Defense Initiative. These contracts are expected to make significant contributions to the technology base for the Ground-Based Interceptor.

The 15 studies will last 4-6 months each and are focusing on a full range of technologies, from interceptor components to kinetic kill vehicles, for the GBI Experiment (GBI-X) portion of the Ground-Based Interceptor program. Results of studies will be available to industry for the follow-on GBI-X Concept and Technology Integration phase.

The GBI-X effort is structured to introduce advanced Ground-Based Interceptor technologies, resolve GBI technical issues, and provide two or more competitors for the full-scale development of a Ground-Based Interceptor.

An element in the Phase I Strategic Defense System architecture, the Ground-Based Interceptor is non-nuclear and would be launched into space to destroy nuclear reentry vehicles from strategic ballistic missiles during the long midcourse portion of their flight (sometime after their post-boost deployment in space and before their reentry into the atmosphere).

Views and opinions expressed in this paper are those of the author and do not represent views or opinions of the Defense Systems Management College, the United States Air Force or the Department of Defense.

GOAL FOR IMPROVING DEFENSE ACQUISITION PROCESS

Lieutenant Colonel Richard B. Rippere, USAF

July 1989 saw release of Secretary of Defense Dick Cheney's *Defense Management Report to the President*. This is a response to the Packard Commission recommendations on Department of Defense acquisition and the 1986 Goldwater-Nichols Defense Authorization Act, which were in response to a persistent belief that the defense acquisition process needed improvement. Mr. Cheney's report announces changes and initiatives directed at implementing specific Packard Commission recommendations. It is too early to tell if the implementation by the military services of Mr. Cheney's plan will produce meaningful changes.

Proposed initiatives are to be commended and will, hopefully, be the first in a series of Total Quality Management (TQM) process improvements. I found the report to be lacking, however, in that I did not perceive a unifying sense of direction. Secretary Cheney does not define the problem explicitly and, thus, does not focus on a solution. I hoped the report would address the inherent validity or appropriateness of the current process and, perhaps, the need for a new or revised process. It did not. While the report has some specific short-range objectives, it does not establish a long-term goal toward which improvements and future initiatives are to be directed. Instead, it addresses individual, piecemeal recommendations of the Packard Commission.

History

Earlier, implementation of the Defense Acquisition Board (DAB) process and Federal Acquisition Regulations (FARs) were attempts to put strong management control on the process. Explicitly defining and regulating acquisition procedures, these did little to foster a total quality management culture change. In fact, the traditional acquisition culture (complicated specifications, requests for proposals, and program management oversight of contractor research, development and production) became more firmly entrenched. Attempts to streamline the process met the resistance of these controls.

One notable improvement effort was that of Dr. W. J. Willoughby, Jr., then Chairman of the Defense Science Board Task Force. The task force produced the *Risk Management Templates* published in DOD 4254.7-M "Tran-

sition from Development to Production." Another early and significant step was establishing in 1971 the Defense Systems Management College (DSMC) by then Deputy Secretary of Defense David Packard. The Goldwater-Nichols Defense Authorization Act now makes DSMC training mandatory for program managers. Through total quality management improvements we may improve the efficiency with which we execute the current process, but it is still the same process. It is still slow, cumbersome, and expensive.

No Definitive Goal

As I have stated, I attribute this lack of significant change to the fact that no definitive goal has been established for change or improvement of the acquisition process. Secretary Cheney's report recognized Packard Commission objectives of emulating characteristics of the most successful commercial and government projects, and of greater reliance on commercially available products. It strongly recommended legislative reform in this area, but stopped short of making this a primary goal.

There have been modest changes in this direction that I feel will prove significant as they gain acceptance and are used more widely. These include multiyear procurement, emphasis on non-developmental items, and the industrial modernization incentives program. Each has the effect of bringing systems acquisition more in line with normal commercial business practices.

Commercial Business Practices

The commonly accepted objective seems to be to conduct defense acquisition business like a commercial business. We need to learn from normal commercial business practices, reduce red tape, let industry do its own research and development, and buy defense systems off-the-shelf. Our initiatives should be oriented toward this goal.

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To understand what this means and its implications requires thought about those market forces and how Department of Defense acquisition business compare. When left to their own devices to compete today in the commercial marketplace, what do successful manufacturing industries do? How do consumers respond?

Fair Competition

One, businesses in the free marketplace exist in an environment of fair competition that provides a reasonable profit at a reasonable price. Quality products result from this competition and the consumer is satisfied or buys from someone else. Except for antitrust and contract laws, commercial businesses are not constrained by the many regulations imposed on the defense industry.

Two, industry forecasts and anticipates market demands. Corporate resources are committed to researching the most promising technical ideas. Companies incrementally develop and market improved products, sometimes meeting consumer demand and other times creating the demand. Defense industries tend to wait for government research and development contracts since it is nearly impossible to forecast Department of Defense market demand.

Remain Competitive

Three, corporations make economic decisions regarding investment in modernization, facility development, personnel, etc., to remain competitive. They must replace depreciated facilities and capital equipment, just as they must invest in modern design and manufacturing technology. Normal commercial business practices do not de-incentivize such investments, as do many government procurement policies and practices. I'm thinking of fixed-profit provisions of cost-plus contracts as a good example; when profit is a fixed percentage of cost, improvements mean less profit—not more. The root of these investment decisions is the bottom-line profit in the competitive free market. Modern processes provide improved efficiency

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and quality, higher marginal profit, and better value for the consumer's money.

Four, commercial businesses make long-term financial decisions based on a more stable economic environment than is the congressional annual budget process. This stability is subject only to fluctuation of the economy. Stability makes these decisions easier, allowing more confidence in the outcomes. Customers make buying decisions based on the same stable environment.

The Goal

My suggested goal is for the Department of Defense to purchase its systems as would any free-market customer. Mostly, this would mean off-the-shelf purchase; i.e., non-developmental item acquisition of nearly everything. Admittedly, the process would not be simple or could it be implemented overnight, but the concept is worthy of consideration.

We generate voluminous requests for proposals detailing specifications. With off-the-shelf purchasing, the re-

quests for proposals could simply state: "We want a better widget; tell us what you've got, how soon and how many you can deliver; be prepared to return tomorrow to compete for another incremental order." Functional specifications would be replaced by functional source-selection criteria.

Three Responses

Such a request for proposal would evoke three responses from industry.

First, there would be immediate proposals describing current inventory of widgets available now at competitive prices.

Second, there would be internal research and development for far better widgets tomorrow (they only have to be a little better to compete for the widget buy tomorrow and further improvements would follow for later buys).

Third, faced with the necessity to remain competitive, industry would make appropriate investments to improve plants and processes without needing the government-sponsored industrial modernization incentives program. These investment costs would appear "tomorrow" in the price of an improved widget but the Department of Defense customer would benefit long-term from the improved process, product and production efficiency. Industry needs the assurance that the customer, the Department of Defense, will be purchasing products tomorrow; i.e., multiyear procurements.

What Is a Widget?

How will industry know what a widget is without a detailed specification? For example, for second-source or component breakout we have been buying technical data packages from original developers and including them in our specifications. If we based our purchase selection on life-cycle costing, and de-emphasized pushing capability past state-of-the-art, it would not matter if replacement parts were unique or generic. In fact, to limit costs, manufacturers would opt for non-developmental parts (generic) whenever possible.

That may work for parts, but not for major systems. How will industry know what we want a new tank or a ship or a plane to do? The answer is the same: We won't tell them in specific terms.

We'll ask for a better tank, and let contractors incorporate current state-of-the-art and their internal research and development into the rapid delivery of a tank. State-of-the-art tomorrow will go into tanks of tomorrow. If Contractor A is producing tanks, Contractor B will be producing other heavy vehicles; but, each will present potential competition for the other. Perhaps we'll maintain a mixed inventory of A and B tanks and A and B vehicles.

Where to Invest

How will industry know what long-term development efforts to invest in; i.e., internal research and development tomorrow and next week? What will be their incentive?

The second part of this question is most difficult. It requires a new level of defense procurement stability commitments akin to multiyear procurement. Industry must have government assurance that projections will remain valid for a defined time. The Department of Defense will define future threat, and the force structure and mission needed to counter that threat. The key factor will be for the Department of Defense to work with industry to understand the uncertainty in "threat projection" and to tailor long-term growth and development plans accordingly. Force-structure plans lead to projection of future operational trends and purchasing levels of weapon systems and support systems.

Industry can use its market analysis and technology assessment tools to make decisions, again in consultation with Department of Defense elements, regarding long-range advanced research and development based on these projections. If necessary, the Department of Defense can provide seed money for internal research and development that is military-unique. Developments can be integrated into

products and systems on an incremental basis, like evolutionary software development is done today. Continued emphasis on life-cycle costing would ensure using modularity and form, fit and function or generic parts commonality.

Procurement cost estimates would be based on true costs incurred; not on over-optimistic expectations or low-ball buy-in bids. Military Specifications and Military Standards would not be needed. Contract administrators and plant representatives would not be needed. Many contract officers and legal staff would not be needed. Cost overruns would become extinct. Budgeting would become a science rather than an art. The Congress would love us!

Force-structure
plans lead to
projection of future
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systems and support
systems.

Conclusion

The formula is simple. The government must communicate long-term needs and intentions to industry. This must be clear enough for industry to focus on areas of highest beneficial growth and improvement. Industry would implement a continuous process, as well as product improvement, to provide state-of-the-art systems to meet Department of Defense needs. The Department of Defense must learn to accept what is offered from the shelf, rather than specifying requirements for uncertain development. The items on the shelf will do the job today, if we can help industry project needs of today. These include the life-cycle cost need for reliability, maintainability and supportability.

The Department of Defense should not manage industrial research and development or forecast technological development; its forecasting should concentrate on the threat and force structure to meet that threat. The Department of Defense should stop trying to regulate the way the defense industry operates internally. Policing industry behavior should be left to the Departments of Justice or Labor.

Half-baked? Ridiculous? Think about it.

We can buy things off-the-shelf today too numerous to mention.

It's difficult to imagine off-the-shelf B-2s, Trident subs, moon stations, etc., but many of their components *may* be suitable for off-the-shelf buying. The government must sometimes assume the development risk; application of these principles to any system acquisition should prove beneficial.

Even if we never achieve the ultimate goal, we *have* a goal, and each step will be in the same direction—the right one.

PROGRAM MANAGEMENT

Pearls of Wisdom

Paul J. McIlhaine

The Defense Systems Management College has been host to hundreds of guest program managers who spoke about their assignments. A question often asked by students is: "What qualities are most important in a program manager?" Replies include necessary characteristics such as leadership, integrity, communication skills and the ability to work with people. Many guest program managers caution that in dealing with an often challenging situation, the program manager must retain the ability to laugh and maintain a sense of humor.

I recently completed a 9-month developmental assignment at the Naval Air Systems Command on the Advanced Air to Air Missile (AAAM), the follow-on missile to the AIM-54C Phoenix Missile on the F-14 aircraft. During this critical period, we faced many obstacles. The one thing keeping the team going was the diversity of characters on the industry and government teams and their unique sense of humor.

I gathered many nuggets of sage advice or, as they are better known to AAAM people, "The Pearls of Wisdom." Some of them follow:

Fire and Smoke Is Greater Than Light and Truth......an experienced program manager summarizing his acquisition strategy.

No Man Can Command the Future—Especially When the Congress Is Involved......a tired contracting officer facing continued congressional micromanagement.

We're Both Fumbling Around With Dem/Val. We Need to Synchronize Our Fumbles......a wearied industry manager eager to get on contract and moving.

The Important Is Overcome by the Tyranny of the Urgent......a harried deputy program manager in the middle of another "fire drill."

They Are a Speed Bump On the Road to Procurement......a frustrated contracting officer dealing with matrixed support.

Why Were All My Nice-to-Have Items Deleted?......a bewildered company executive.

The Bitterness of Poor Quality Remains Long After the Sweetness of Low Price Is Forgotten......a visionary support contractor calling for a long-term perspective.

Whoever Put That Sentence in the Statement of Work Ought to Have His Head Examined—oh! he works for me......an initially outraged but later humbled field activity manager.

Stranger Things Have Happened—What We Now Have Are Two Concepts That You Must Weigh With the Baloney Factor......an experienced program manager entering source selection.

Those Safety People "Wrap Themselves in Their Safety Blanket" and Then Get Whatever They Want......a fatalistic deputy program manager overcome by a matrix organization.

That Would Be Like Rearranging the Deck Chairs on the Titanic......a government contracting officer's negative retort to his industry counterpart.

O.K., You Gave Me the "Dummie" Test and I Failed......a distinguished government program manager in rare display of humility.

This Move Should Allow Us to Draw the Fig Leaf of Respectability Over Our Program......a government contracting officer observing much form but little substance.

I Don't Have the Power To Say Yes; However, Like All Bureaucrats, I Have the Power To Say No......a seasoned functional manager matrixed to a program office.

I Can't Fall Forward Very Easily But I Can Always Fall Backward......a program manager facing risky but promising new technology.

When We Face the Bill in 3-5 Years, I Don't Want to Be Forced to "Drop Back and Punt"......a program manager being advised to "trust your contractor."

I Don't View That Meeting As a Disaster; Rather It Represents a Door Opening to a New and Wondrous Spring......a deputy program manager clearly putting on a "happy face."

Where Is the Purity in This Business?......a disillusioned academic reacting to real-world events.

He's Getting Easier to Read, but You Still Don't Know Where You Stand on the "Shades of Grey" Scale......a program manager emerging from another meeting with his boss.

One of My Biggest Problems on This Program Is to Keep My Procurement Contract Officer from Committing Suicide......a deputy program manager facing another change in the program.

A Surrogate Seeker on This Program Would Be Like Getting a Date with Farah Fawcett and Going Out with Miss Piggy Instead......an industry manager attempting to delay a proposed government approach.

You'll Never Get That Program Started Today Unless You're More Devious......a retired but very experienced government employee.

There Aren't a Lot of Really Brilliant People in This Program But There Are a Lot of People Who Think They Are Really Brilliant......a seasoned technologist.

The Forces of Evil Are Always Fully Funded......a fatalistic Pentagon program sponsor facing another budget drill.

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ARE YOU READY TO MAKE AN AUDIO OR VIDEO PRESENTATION?

David D. Acker

Before answering yes to the question posed above, there are things worthy of your consideration. Think about them.

In recent years, more communications of an informational nature have been transmitted by audio recordings and videotapes. The latter soon may dominate the information media in government, industry and education. It provides a way to send a televised message at a relatively low cost to groups in offices, industry, schools, colleges and universities. One growing area is medical television.

You should recognize from the start that the medium affects message impact. What takes place on an audiotape or videotape is being judged by the same standards as those for first-class radio presentations or prime-time television. The audience is sophisticated. On a videotape, the audience won't tolerate someone sitting quietly behind a desk looking and speaking into a camera. The audience expects more and will have to receive more if the speaker(s) wants undivided attention.

The recording technique is *not* more important than the information presented. The primary purpose is to communicate specific information. We don't excuse a poor presentation when it is neither interesting nor entertaining.

To make an effective presentation in your field of expertise, be it from a platform for a live audience or before subordinates, superiors, visitors or students, you must know the rules of the game. You must learn what does and what does not work well. When you are asked to make an audiotape or videotape, it may be a new "ball field" for you. Many techniques you may have learned to master on stage are applicable but there are new ones to learn if your presentation is to be first-rate.

Professor Acker is a senior member of the research staff in the Department of Research and Information at the Defense Systems Management College. This article will be a new chapter in the second edition of his widely acclaimed book Skill in Communication: A Vital Element in Effective Management which is planned for publication in 1990.

Things to Consider at Outset

Speaking before a live audience, you communicate through more than one channel. Words selected and their sequence constitute the primary message. The secondary channel(s) through which you communicate concerns how you present the primary message; i.e., how you use voice and body to deliver ideas and supporting material.

In an audiotaping or videotaping there is a similarity in that your words and their sequencing, and your voice, are important. In video presentations, vocal delivery must be accompanied by effective body language and good eye contact (or contact with the eye of the camera).

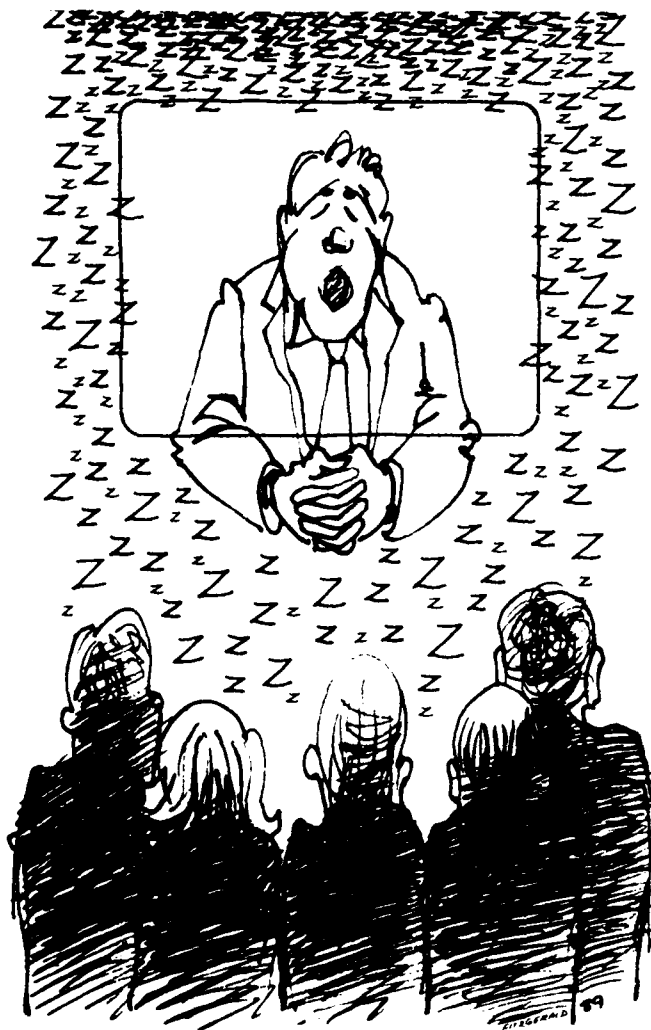
In either medium, vocal loudness or softness must always be considered. So must vocal speed, which impacts upon audience interest and understanding. Generally, avoid a machine-gun rate of vocal delivery, except for a dramatic effect.

Everyone has a normal pitch range; some are high, some are low. An effective speaker varies pitch range to match intensity of the primary message.

When seen on a videotape, you probably express more non-verbal messages through facial muscles and eyes than through any other part of your body. In fact, you generally express feelings and awareness by your facial expressions in daily conversation. Thus, it is important to understand that facial expressions produce secondary messages that reinforce, or detract from, ideas you want to express.

When videotaping, your body movement is very important. Movements and gestures can add or detract from what you say. Random or repetitive body movements distract viewers' attention from your primary message. At the outset, you should know how you plan to start your presentation. If you hesitate, appear frightened, or spend too much time arranging materials, you will not make a positive first impression.

Before getting involved in details of an audiotape or videotape presentation, there are points needing attention.



Before getting involved in details of an audiotape or videotape presentation, there are points needing attention.

- Select a topic you know, preferably one you know a lot about. Chances of success are greater if you feel comfortable with your subject.

- Determine at the outset who the audience will be because your message should be audience-centered. It is difficult, if not impossible, to have an effective message when you don't have

a target audience in mind. When you know your audience, you are ready to begin preparing the message.

- Before starting, outline the message. Identify important points, issues to raise, arguments to support the message, and the final conclusion. Keep on target.

Ralph C. Smedley wrote that "A speech (or presentation) without a specific purpose is like a journey without a destination."

Audio Recording

Audio recording is widely used to impart information, but since telling is involved and the audience cannot interrupt to ask questions, interaction normally occurs after the recorded presentation. Interaction may be limited to questioning the person playing the recording, and that person may not have initiated the recording.

Rarely does the recording person speak extemporaneously; usually, there is a detailed set of notes or prompts. Sometimes the speaker may read word-for-word from a prepared script. If you are making a recording, allow time for detailed planning and preparation before recording a message using any of these techniques.

Most lectures are illustrated. This is not possible with an audio recording although illustrative material may be available with the recording. If not, the person making the recording must use all resources (good stories and illustrative examples, effective voice inflections, dramatic pauses, and other techniques) to hold the interest of the listening audience.

An audio recording has these advantages.

- The recording can cover much material in a short time.

- The recording can be used for beginning and advanced audiences (learners), provided they are motivated.

- The recording can be used by different size groups, provided the recording can be clearly heard.

—The speaker recording has complete control of the content and sequencing of information, and is not interrupted by the audience.

Disadvantages of an audio recording are these.

—The message involves one-way communication. There is little or no way to check that the information was clearly transmitted or ideas were clearly understood.

—The audience is largely passive because there is essentially no participation and involvement.

—The attention of the audience may have to be maintained for a long time. This may be difficult.

—An audio presentation may be difficult or inappropriate for practical subjects, like the acquisition of skills.

Audio recordings should be used with discretion. Long presentations are difficult to sustain. Short ones can be very successful, even if the speaker is not skilled. Always, the speaker must have credibility with the audience.

Finally, it is important to recognize that when an audio recording is used, the speaker on the recording must be introduced properly. Do not skimp on the introduction to allow more time for the recorded presentation. Before the recording is played, it is imperative that the audience appreciate the speaker's qualification to address the audience on the subject chosen.

Videotaping

The discussion regarding audio recording applies to videotaping, but there are more things to consider. These are set forth in the following paragraphs.

On video, a neophyte should not attempt to imitate a professional orator admired for smooth delivery. It is a dangerous game to play and usually appears artificial to the audience.

The most important rule is to "be yourself." There is no distance between audience and speaker, no place to hide, and there is no way for the speaker to conceal uneasiness. The advice to "be yourself" and forget you are being televised may be oversimplification. There is nothing natural about the studio or stage setting of cameras, lights and restrictions. However, after becoming familiar with this environment, you may grow accustomed to it and be effective.

If you are inexperienced with videotaping, here are suggestions you may find helpful.

—Use a Script. Read it and don't depart from it. The disadvantage of reading the script is that the audience cannot see your facial expressions and measure your sincerity and enthusiasm. Using a teleprompter or cue cards (a.k.a. idiot cards) can be helpful.

—Rehearse. Conduct enough rehearsals to ensure a smooth delivery. If you must read the script, don't hide the fact. It is better to use a key-word or key-phrase outline to keep on track. It is always more believable to paraphrase, or speak extemporaneously, than to read a script or recite something from memory.

—Practice Timing. This must be worked out and rehearsed in advance. Remember that timing is important but audience attention is more important.

—Speak Distinctly. A key consideration is voice quality regarding articulation, tone and pace. The voice should have a natural flow, a conversational style and be accompanied by natural gestures and movements.



"Be yourself."

—**Remember, Video Is a Visual Medium.** It is not necessary to maintain a constant flood of words to capture attention. A simple movement like walking across the stage or to a blackboard is attention-holding. Looking from the camera to one's notes, to pick up the next thought, grabs viewer attention. The audience will be patient and wait for words when they see what is taking place.

—**Be Subtle.** Use small gestures (not broad ones), a frown, or a quizzical expression, all of which communicate directly. Avoid hand motions near the face.

—**Consider Attire.** On a videotape, contrasts in color and value "bloom" and detract from the presenter. Solid colors are best. If two or more people are involved, they should wear grey or dark clothing to avoid unpleasant contrasts of color or design. Light colors attract more attention than dark ones and tend to distract attention from the speaker's face. Women's jewelry often reflects studio lights and causes sharp, distracting highlights in the video picture.

—**Stay Calm.** If you make an error, or wish to rephrase, continue the presentation and don't panic. Try to verbally correct the error if possible, but you may have to continue the presentation and take corrective action later.

Graphic Materials

Graphic materials convey information and add to presentation effectiveness. Graphic materials include visual materials from the settings where the action is staged to simple captions identifying a speaker on the important message points. Each visual element must contribute to the message and elements selected for aesthetic, functional, practical, and/or expositional purposes require consideration. Good graphics are simple graphics.



Lights, camera, distraction!

Closing Thoughts

I have concentrated on audio and visual techniques to make effective presentations. Selecting the appropriate method depends upon many factors. In making the final choice, a most important factor is understanding needs of the audience; another is your personal preference for the best media to use. The nature of the task may tend to influence whether to make an audio or video presentation, but the final decision is not always up to you. When you are the presenter providing information to an audience, my suggestions are appropriate to consider for

a live audience or for making an audiotape or videotape in a studio. The audience and the message must receive primary considerations. Don't forget that the message may get lost if you become too involved in "staging" the presentation.

Now, you should be able to answer the question: Are you ready to make an audio or video presentation? Let's hope your answer is in the affirmative.

This paper does not represent the official position of the Air Force Institute of Technology or the Department of Defense. It summarizes the Management Control Systems lecture developed and given by the author in three criteria courses at AFIT.

MANAGEMENT CONTROL SYSTEMS THEORY IS USEFUL TOOL

Captain David S. Christensen, USAF

Management Control Systems (MCS) theory is a useful integrative tool for organizing, explaining and understanding the jargon and concepts of performance measurement. The theory can help make sense of the criteria by providing a way of organizing and remembering it and the related jargon and concepts. A good place to start in understanding the relationship between the criteria and the Management Control Systems theory is with the stated objective of the criteria:

To provide an adequate basis for responsible decision-making by both contractor management and DoD Components, contractors' internal *management control systems* must provide data which (a) indicate work progress, (b) properly relate cost, schedule and technical accomplishment, (c) are valid, timely and auditable, and (d) supply DoD managers with information at a practicable level of summarization (DoDI 7000.2).

The phrases "responsible decision-making" and "management control systems" are important. The criteria are intended to foster responsible decision-making by setting minimally adequate standards for the contractor's MCS. But, just what is responsible decision-making, what is its relationship with the criteria, and what is MCS? This paper answers these questions. The intent is to build a conceptual framework useful for explaining and understanding the criteria.

Responsible Decision-making and Information Quality

A responsible decision is one based on information. A responsible decision-maker will use information, which is different from data. Information is data that is useful for decision-making. Cost and schedule performance data provided on the Cost Performance Report (CPR) or Cost/Schedule Status Report (C/SSR) must thus be aggregated, filtered, analyzed, or otherwise tailored to the decision problem and to the decision-maker to transform it into information.

Before data are converted into information and used in decision-making, the responsible decision-maker should (1) have some role in specifying the content, format and frequency of the information and (2) evaluate the quality of the information provided. Both of these tasks are addressed in Department of Defense instructions. The DODI 7000.10 addresses the information requirements by specifying the

format, timing, and content of the CPR and C/SSR. A decision-maker can tailor these reports to a specific decision problem by defining the desired level of detail in the reports and the specific formats needed. Discovering just the right level of detail, format, and timing is termed information requirements analysis, and is a major research area in management information systems and accounting. Sometimes the manager does not know what information is needed, requests too much data, and suffers more from an abundance of irrelevant data than from a lack of information—a phenomenon termed "information overload."¹

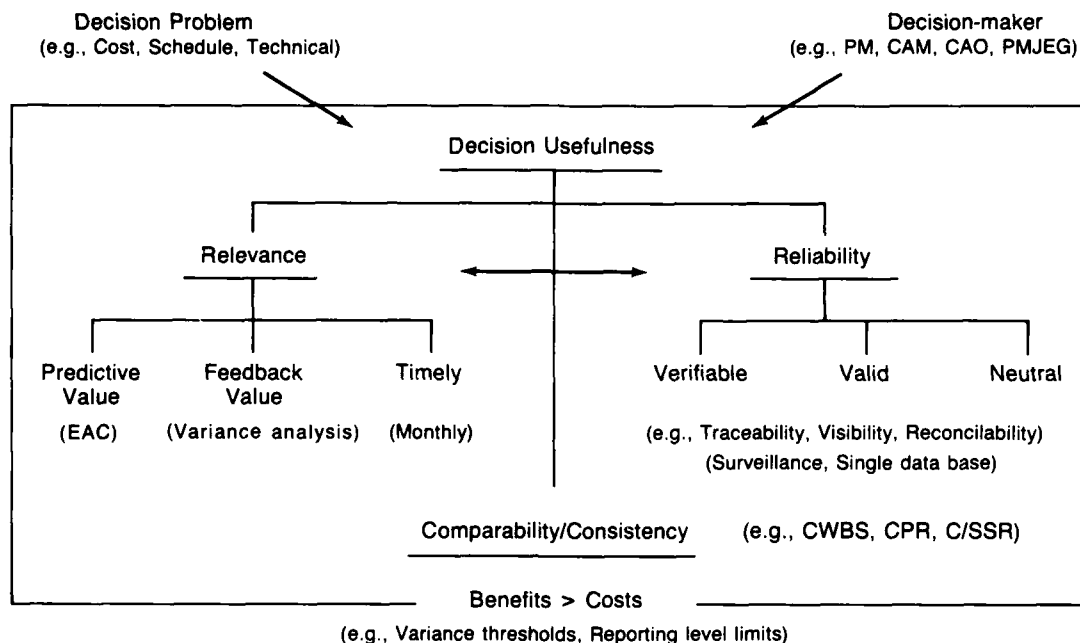
The responsible decision-maker should be concerned about the quality of information provided by the contractor. Whenever the preparer of the data/information is different than the user, there is a potential for conflict of interest. For example, investors and creditors use a company's financial statements to evaluate the investment or credit potential of a company. A company wants to attract investors and creditors and strives to present itself on its financial statements in the most attractive way possible. Similarly, the contractor prepares the CPR or C/SSR. The government uses the report to help evaluate the cost and schedule status of the project. The contractor has considerable economic incentive to "strategically manipulate" the data. The Nunn-McCurdy Amendment (1983), for example, can result in suspended obligations to contracts with cost overruns in excess of specified thresholds.

Cost Overruns

Contractors may be tempted to disguise early cost overruns by manipulating the performance measurement baseline (PMB). In one technique, budget for the initial effort is overstated ("front-loading"). In another technique, budget for downstream effort is moved forward to cover current cost problems ("rubber baselining"). The effect in either case is to mask early cost variances. The hope is that the eventual cost overrun for the far-term effort will be masked by contract changes. Clearly, biased performance measurement and reporting are not desirable. The criteria address these by setting minimal standards for a contractor's Management Control System.

Captain Christensen, Ph.D., is assistant professor of accounting, School of Systems and Logistics, Air Force Institute of Technology, Wright-Patterson Air Force Base, Ohio.

FIGURE 1. INFORMATION QUALITY AND CRITERIA JARGON



Information is of high quality if it is relevant and reliable (Figure 1). Reliable information is necessarily bias free, valid and verifiable. Relevant information should have feedback value, predictive value, and be timely.² Key performance measurement criteria thus require the contractor to regularly compute Estimates at Completion (EAC) and conduct detailed variance analysis. The criteria also foster reliable data/information by requiring an elaborate system of accuracy checks (e.g., "rolling up" the cost data through Contract Work Breakdown Structure and functional lines) and periodic audits (e.g., surveillance visits). Criteria "ilities" like reconcilability, traceability, visibility, etc., permeate the *Joint Implementation Guide* (JIG) and other criteria literature. Their intent is to ensure that the data provided by the contractor are reliable. But there is a trade-off between achieving relevant and reliable information. Spending too much time to ensure validity of the data, for example, can make it useless for decisions requiring timely information.

Consistency and Comparability

Other qualitative characteristics of information include consistency and comparability. Data on cost/schedule performance reports should be consistently prepared through time and (ideally) between contractors to achieve comparability. One way that the criteria foster comparability and consistency is by using the Contract Work Breakdown Structure (CWBS) for organizing, analyzing, and reporting performance data. Because an overemphasis on uniform reporting can mask true differences between contractors, the criteria also emphasize flexibility and allow tailoring. Many guidelines in the *Joint Implementation Guide* describing the criteria are intended to be "rules of thumb" rather than hard requirements.

The criteria are directly concerned with receiving quality information from the contractor. The DODI 7000.2 and the *Joint Implementation Guide* identify 35 characteristics (criteria) that every "well-behaved" MCS should possess. The implicit assumption is

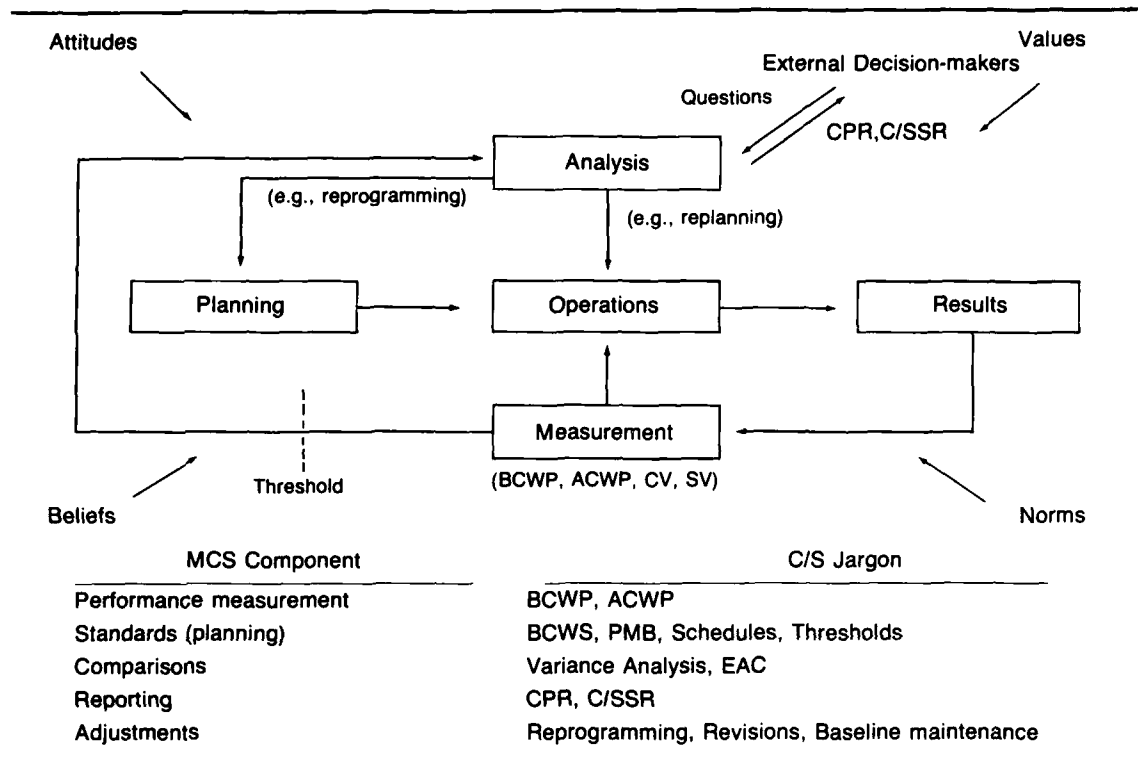
that if the MCS is criteria-compliant, then the data/information generated by that system are of high quality.

A Generic MCS and the Criteria

An MCS is a *system*, which is an aggregate of machines and people working toward a common objective. A system can be described as a series of steps or phases, consisting of an input phase, a processing phase, and an output phase. A *control* system adds measurement, analysis and reporting phases to the system. Output is measured, compared against a plan, analyzed if judged significant, and then reported back to the appropriate earlier phases of the system in the form of positive or negative reinforcement. In a *management* control system, data/information is typically feedback to managers of the various system phases. Responsible managers will then take appropriate action based on the data/information provided.

To help ensure that the data/information supplied is of high quality, the MCS must have certain characteristics. As indicated in Figure 2, every MCS

FIGURE 2. A GENERIC MCS MODEL AND CRITERIA JARGON



has certain generic components.³ There must be a reliable performance measurement system. Realistic standards should be planned and maintained. The standards should be consistently and regularly compared with the performance measurement data. Any variances that exceed predetermined thresholds should be enthusiastically investigated and reported to people in the system having responsibility and authority to make appropriate and timely adjustments. All adjustments should be controlled, especially those affecting predetermined standards and thresholds.

The criteria are organized into five categories that correspond to the generic MCS components. The categories are organization, planning and budgeting, accounting, analysis, and revisions/access. While the criteria do not specifically require the CPR or C/SSR, the MCS feedback function is essential. The CPR and C/SSR are the formal feedback reports developed to partially satisfy this function. Neither the contractor nor the government is restricted to exclusive use of these formal reports for management of the

contractual effort. These formal reports are just one of many management tools. Informal information systems are necessary and expected.

Organization Category

The organization category is particularly important. The criteria require the contractual effort to be defined via the Contract Work Breakdown Structure and assigned through functional lines. The criteria generally describe the intersection of the Contract Work Breakdown Structure and functional lines as the Cost Account (CA), the person responsible for which is the Cost Account Manager (CAM). The Cost Account is the focal point for integrating the planning, scheduling, performance measurement, and analysis functions of the system. The Cost Account Manager is responsible for this integration.

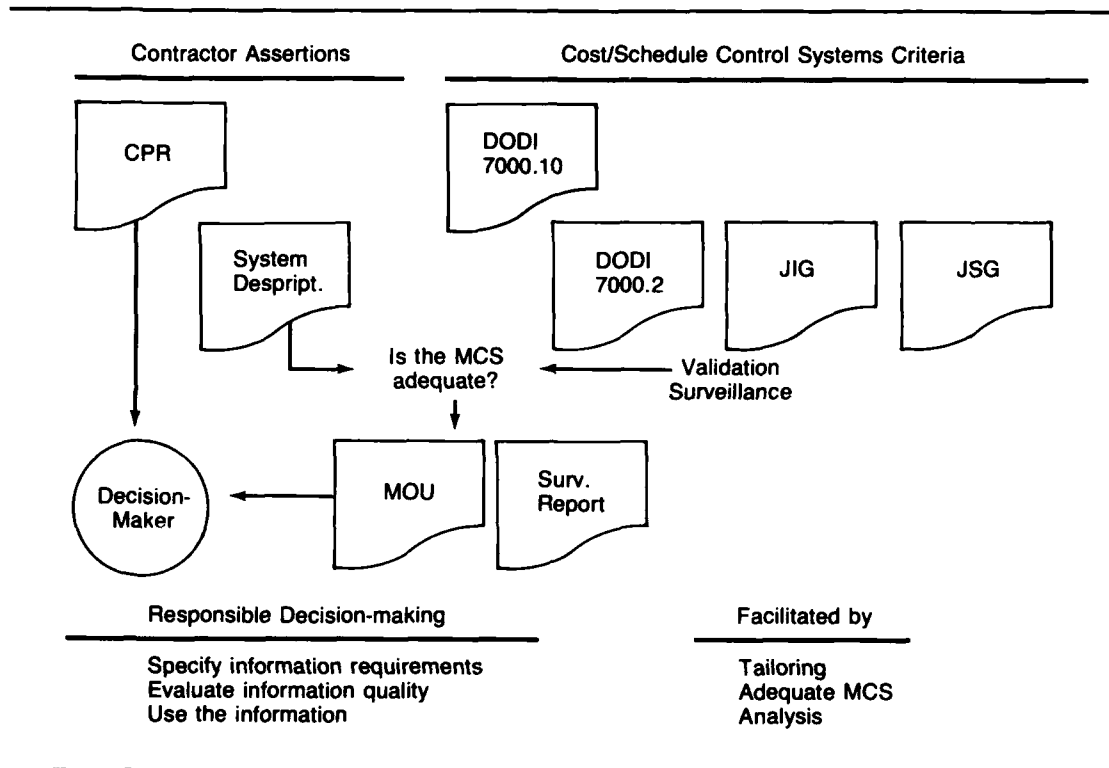
Beyond the important task of defining and assigning the work, there are other organizational factors that can influence the effectiveness of a Management Control System. Two of these are organization structure and culture. Organization structure is its set of rules and interrelationships.

Organization culture comprises beliefs, values, norms and attitudes shared by people in the organization. Certain aspects of an organization's structure facilitate control by reducing variability (e.g., internal operating procedures and functional specialization). Other aspects of organization structure can influence the effectiveness of the decision-making process (e.g., degree of centralization).

The Japanese Attitude

Similarly, the culture of an organization can drastically affect viability of the MCS.⁴ For example, for many years the Japanese attitude regarding a variance and variance analysis has been exemplary. To the Japanese automobile manufacturer, a variance is a treasure. It is doubtful that a similar attitude was held by American automobile manufacturers. The result has been a wide disparity between the quality of Japanese and American automobiles. Many American factories have begun to recognize this problem and foster new cultural attitudes among employees. Ford's slogan, "Quality Is Job 1," is indicative of an attempt to change organizational culture. With respect to the Depart-

FIGURE 3. CONTRACTOR ASSERTIONS AND THE CRITERIA



ment of Defense Cost Schedule Control Systems Criteria program, if either contractor or government does not support the criteria, it is likely all aspects of the Management Control Systems will fail. Performance measurement reports will be useless. Subsequent analysis of reports will be to no avail. Decisions that may have benefited by the information derived from reports will be made less responsibly.

The criteria do not prescribe either an organization's structure or culture. The structure is more a function of uncontrollable external factors, such as the type of work (e.g., research or production), the required technology, and the magnitude of the contractual effort. Accordingly, structure is difficult to change. The organizational culture is also difficult to change, but can be influenced by committed managers. High-level government and contractor managers should continuously express their confidence and interest in Cost Schedule Control Systems Criteria. Mid-level managers in key positions (e.g., program managers, cost account managers, review directors, and team chiefs) should be com-

mitted to a quality MCS and be aware of the severe system problems created by improper attitudes and beliefs.

Summary

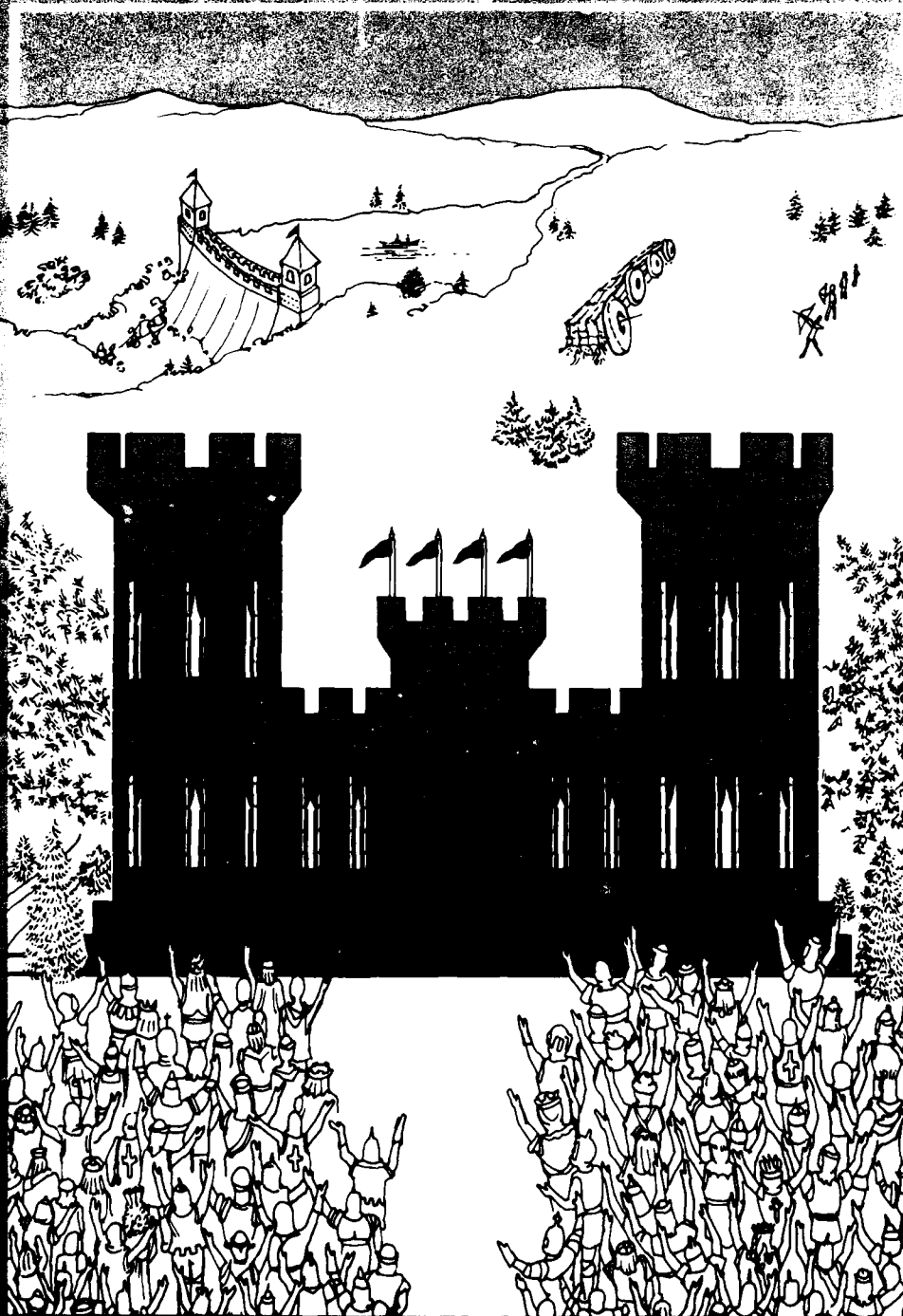
As illustrated in Figure 3, the contractor provides performance reports to decision-makers, who include a variety of people and functions at various organizational levels. A responsible decision involving the contractor's cost/schedule performance should be based in part on the data provided on the reports, if that data (1) have been properly tailored to the specific decision problem, and (2) are reasonably relevant and reliable.

If the contractor's MCS is criteria-compliant, then the data provided by the system are assumed to be of high quality. The memorandum of understanding and subsequent surveillance reports convey government confidence that assertions made by the contractor in the form of performance reports and system descriptions are reasonably justified.

These "comfort letters" are valueless, however, if the organizational culture concerning the criteria is defective.

Endnotes

1. For more on this point, see R. Ackoff's "Management Misinformation Systems," *Management Science*, 1967.
2. This framework has been adapted from the Financial Accounting Standard Board "Statement of Financial Accounting Concepts No. 2" (1980). It is used with FASB permission.
3. This cybernetic depiction of an MCS has been adapted from E. Flamholtz's "Accounting, Budgeting and Control Systems in Their Organizational Context: Theoretical and Empirical Perspectives" *Accounting, Organizations and Society*, 1983. It is used with his permission. A cybernetic MCS model is not the only way of describing MCS functions.
4. For more on organizational culture, see Elmes and Wilemon, "Organizational Culture and Project Leader Effectiveness," *Project Management Journal*, 1988; and W. Ouchi, "A Conceptual Framework for the Design of Organizational Control Mechanisms," *Management Science*, 1979.



CORPS OF ENGINEERS

KEEPING CUSTOMERS HAPPY

C. Mark Dunning, Ph.D.

Claudia M. Rogers, Ph.D.

Satisfied customers are a key to success for business and government. Many organizations' commitments to keep customers happy are manifest in *ad hoc* programs involving little more than slogans and consciousness-raising measures. Generally, such programs accomplish little. As more immediate problems demand attention, emphasis on customer satisfaction wanes. In contrast to *ad hoc* approaches, management consultants have recommended organizations approach the issue of keeping customers happy like they do for any other vital activity; that is, through applying consistent and systematic management.

This article describes a systematic approach for keeping customers happy. The Customer Satisfaction Enhancement System (CSES) was developed by the U.S. Army Corps of Engineers to improve delivery of engineering and construction management services to military customers. Key CSES features are customer feedback questionnaires and problem-solving workshops where the service provider and customer develop mutually agreeable ways to address customer-satisfaction issues.

To illustrate the use of the CSES, we describe its application at one of the Corps 37 field offices, the Mobile District in Alabama. This program is tailored to one agency's circumstances, but the model embodies principles valuable to many customer-service situations in government and business.

Corps of Engineers and Its Military Customers

The Army Corps of Engineers (COE) with 38,000 civilian employees is the largest public engineering agency in the world. Principal customers are installation commanders. Their wishes and satisfaction, or lack thereof, generally are communicated through the facilities engineer; for the Army, that person is the Director of Engineering and Housing (DEH); for the Air Force, Base Civil Engineer (BCE). Together with their staffs, they are the most visible and vocal of Corps military customers and are among primary individuals the organization targets for "customer care." The Corps has other constituencies to satisfy including taxpayers footing the bills for engineering and construction management work and who, through committees and agencies, demand value and accountability.

Each district is quasi-independent in performing centrally developed policies and its business.

Editor's Note: The views expressed in this article are the authors' and do not necessarily reflect those of the U.S. Army Corps of Engineers.

Model for Customer Satisfaction Evaluation System

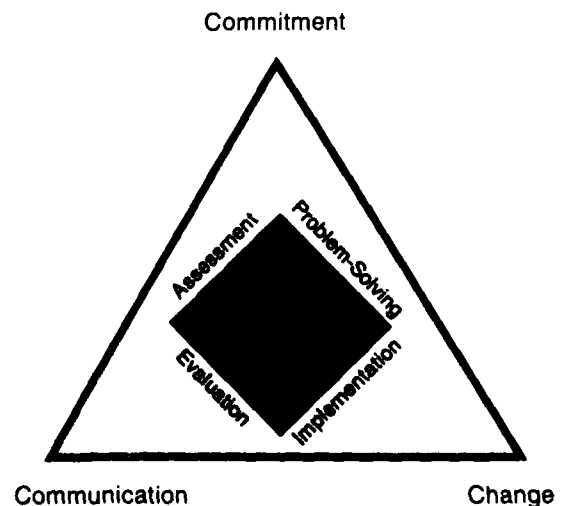
The CSES model (Figure 1) specifies three requirements: executive commitment, communication and change. There are four support activities: assessment, problem-solving, implementation and evaluation.

Commitment means the resolve of district executives to improve customer care, recognizing such a program will involve application of resources and subject policies and procedures to scrutiny. Such commitment is vital to success of the program: Unless commitment is present, the program will fail and may do more harm than good.

Communication effectively identifies customer perceptions of strengths and weaknesses of the quality of services and products and informs the customer of district points-of-view, pertinent information, and actions being taken that might affect those perceptions.

Change refers to modifying customer and district perceptions about quality of service and products. Altering perceptions usually involves fixing the problem—the source of dissatisfaction; however, it may involve providing more information to reevaluate the same situation.

FIGURE 1. MODEL



**FIGURE 2. CUSTOMER SATISFACTION WITH
RPS PERFORMANCE (1987 and 1988)**

PERFORMANCE FACTORS	RATINGS			
	ARMY		AIR FORCE	
	1987	1986	1987	1986
DESIGN				
1. Assistance with program development when requested (1391.PDB, etc.)	•	•		
2. Concept design development and review	•	•	•	
3. Design reflects lessons learned from past mistakes	•	X	X	
4. Adequately addressing safety concerns and features in design	•			
5. Use of standard items vs. outdated non-standard items	•			
6. Timely provisions of design documents	•	•	•	
7. Responsiveness to recommended design changes as a result of user/customer review design	•			X
8. Responding to DEH/BCE review comments	•			
9. Accuracy of cost estimation	•	X		
10. Cost effectiveness of project design	•		•	
11. Conformance of facility to project requirements as originally stated in the program document	•	•	•	
CONSTRUCTION				
12. Preconstruction conferences	•	•	•	
13. Quality of materials and workmanship	•	•	•	
14. Adequate information about project status during construction	•	•	•	
15. Adequate on-site inspection during construction	•	•	•	
16. Staying on schedule	•	•	•	
17. Adequate explanation of schedule charges	•	•	•	
18. Balancing concern for quality with concern for timeliness and cost	•	•	•	
19. Adequacy of coordination between design and construction	•	•	X	
20. Speed in processing change orders	•			
21. Response to customer and/or user requested changes	•	•	•	
22. Timely correction of punch list items	•	•		X
POST-CONSTRUCTION				
23. Acceptance and turnover	•		•	
24. Adequate explanation for cost overruns	•		•	
25. Providing as-built drawings to installation engineer in a timely manner	•		X	
26. Transferring of O&M Manuals	•	•	•	
27. Corps of Engineers support during warranty period	•		X	
28. Contractor warranty execution	•		X	

LEGEND

- X 25 percent
or more dissatisfied
- 75 percent or
more satisfied

Change refers to modifying customer and district perceptions about quality of service and products. Altering perceptions usually involves fixing the problem—the source of dissatisfaction; however, it may involve providing more information to reevaluate the same situation.

The CSES accomplishes these requirements through a program involving assessment surveys, problem-solving workshops and implementation and feedback programs—all monitored and supported by executives within the organization. Each component is described below.

Assessment

The CSES uses questionnaires to start the process of improving communications between Corps and customers. District staff send questionnaires annually to installation commanders and base civil engineers. Divided into four parts, the questionnaire essentially asks: How well have we been doing in providing you with engineering and construction management services?

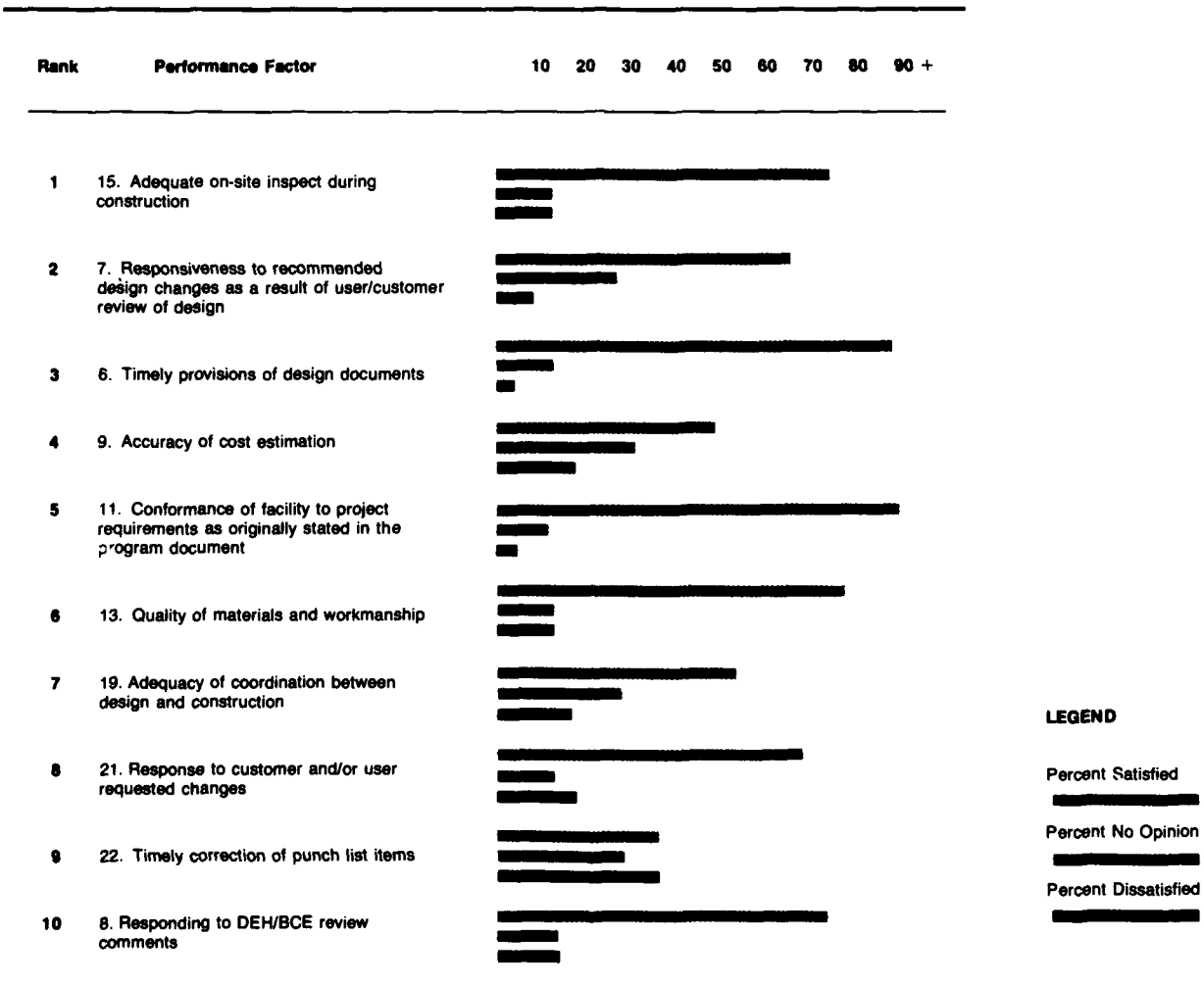
Part I asks for an overall judgment of the respondent's satisfaction.

Part II asks about satisfaction with Corps' performance of 28 key services in the design, construction and post-construction stages of project development.

In Part III, respondents choose services most important to developing a successful project. This ranking helps the district differentiate major from minor problems.

A final section requests occupational data of the person responding. By sending the questionnaire to the installation commander and the DEH/BCE, two levels of customer satisfaction perception are gained.

FIGURE 3. SATISFACTION BY RELATIVE IMPORTANCE RANKINGS/MOST IMPORTANT PERFORMANCE FACTORS



Results of questionnaires are one way to report objectively customers' opinions. Some may feel subjective perceptions are too ephemeral; however, Tom Peters points out in *A Passion for Excellence*:

...perception is all there is. There is no reality as such. There is only perceived reality, the way each of us chooses to perceive a communication, the value of a service, the value of a particular product feature, the quality of a product. The real is what we perceive.

Perceptions are subjective but people generally perceive many of the same situations similarly. Consistencies displayed among customers' satisfaction ratings suggest questionnaires are tapping into something with an underlying reality, rather than obtaining random viewpoints.

When questionnaires' data are aggregated, they point out areas where a district is doing well or doing poorly in satisfying customers. Services felt to be poor are targets for improvement. As data accumulate, a trend of customer satisfaction emerges. Answers

can be given for questions like: How effective have our efforts been at fixing customer-identified problems? Questionnaires provide a valuable source of feedback about problems or situations needing individual attention.

In the Mobile District, questionnaires have been sent out since 1986. Figure 2 shows responses for 1986-87 surveys. Figure 3 shows respondents' satisfaction with the 10 most important Corps' services. Ranking of factors, coupled with satisfaction ratings, allows a quick idea of where district resources should be targeted.

Problem Solving

Questionnaires identify problems. The issue becomes how to accomplish the fix. Most customers have ideas to help. While "the customer is always right," things are more complex. Engineers generally have good reasons for doing things and have strong views. It may be that particular policies have more to do with making life easier for those "inside" the providing organization than for customers. The important point is that there may be insiders with vested interests that need to be assessed. In a military organization, you might think a simple order would bring about desired change, but it is not so painless. Unless a way can be found to satisfy needs of insiders, it is unlikely that "fixes," based on customer suggestions, will be implemented.

James O'Toole in *Vanguard Management* addresses the problem of creating change when noting the need for organizations to broker among competing constituencies:

...shareholders are best served in the long-run when corporations attempt to satisfy the legitimate claims of *all* the parties that have a stake in their companies—consumers, employees, suppliers, dealers, special interest groups, host communities, government, as well as shareholders. In fact, the task of management is defined as resolving conflict between the competing claims of these groups.

The CSES has a similar premise. While understanding that input from the installation customer is vital, there are other important constituencies that need to support plans or changes. Given these complicating factors, the CSES employs problem-solving workshops between customers and the

Corps. Two key concepts are involved in workshops: participation and interest-based negotiation.

Participation: Installation customers and district technical experts work together to develop acceptable solutions. Solutions are more likely to be palatable to customers and the district staff if both assist in their creation and implementation.

Interest-based Negotiation: Trained facilitators help participants engage in interest-based negotiation. This requires district staff and customers to postpone talking about "how to fix" and focus on defining *why* the problem exists, and how they would recognize a good solution. This discipline is oriented to identifying basic interests underlying a particular fix. As presented in *Getting to Yes* (Fisher and Ury, 1981) and elsewhere, by focusing at the interest level rather than on particular positions of parties concerned, it is more likely that solutions can be reached which both sides support.

Implementation

Ultimately, district executives evaluate and decide whether to implement solutions. In the Mobile District, Corps technical experts refined solutions from problem-solving workshops, developing detailed implementation plans containing milestones, persons responsible and resource requirements. Plans were then presented to senior managers for consideration and evaluation.

Evaluation

Continuation of the CSES process enables evaluation of program effectiveness. Each subsequent round of questionnaires measures the effect of prior efforts on current ratings. In the Mobile District, for example, the second round of questionnaires showed improvement of customer satisfaction ratings in many areas, indicating effectiveness of the Mobile program of

customer care initiated in 1986 (Figure 2). It showed some disparity between responses of commanders and facility engineers. Commanders were more critical of district performance on several items, giving ratings of "dissatisfied" in comparison to "satisfied" ratings provided by the engineers. The district response has been to observe closely each problem area involving project manager, area engineer, installation engineer and commander in periodic briefings so that information and ideas are shared and expectations remain realistic.

Lessons Learned

The CSES is being applied in several Corps offices. As experience with the program accumulates, lessons are emerging. Three seem especially important.

—Follow-through is vital once CSES is initiated. The implicit premise in inaugurating CSES is that "we value your comments." If this information is collected and not used, a different message is conveyed. Customers may feel betrayed and instead of improving satisfaction may have a worse perception of the Corps office.

—The CSES is not a "report card." Quantitative information lends itself to analysis and comparison. Unfortunately, comparisons can be used to "grade" performance by superiors and this tendency should be avoided. When used in this way, managers and employees lose incentive to support CSES.

—Executives must recognize that embarking on a CSES program will require resources and must evaluate how intensive an effort they are willing to support before implementation. For example, feedback questionnaires on each project yield the best data regarding customer satisfaction, but require more resources to administer than yearly questionnaires. By care-

fully considering such trade-offs, a program can be developed that executives will realistically and enthusiastically support.

Conclusions

Keeping customers satisfied is important to any organization committed to professionalism and service. Customer satisfaction can be improved by fostering a climate of partnership between service provider and customer. The CSES fosters this climate by applying principles of commitment, communication and change. While the approach to CSES has been tailored to the U.S. Army Corps of Engineers, underlying principles have broader application and, in fact, constitute a basic model for managing customer satisfaction in a systematic and effective manner.

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2. Returns from news agents: None

G. Total distribution: 11,000

USING OPERATIONS RESEARCH IN WEAPONS SYSTEMS ACQUISITION

Colonel Gordon W. Arbogast, USA

The Military Operations Research Society (MORS) is a professional society existing to promote the use of operations research and related subdisciplines, like systems analysis and engineering, in military applications. At the annual symposium in 1988, the new provisional Weapons Systems Acquisition (WSA) Working Group was added. It is said working groups are the "heart" of MORS. At a 3-day symposium, professional papers are presented and panels of senior officers and civilians discuss current topics of interest. At the 1989 MORS, Fort Leavenworth, Kan., interest peaked in weapons systems acquisition and the MORS board of directors declared the working group permanent.

As Chair, Weapons Systems Acquisition Working Group, I feel it important the acquisition community at-large be aware of that meeting's proceedings. In this article, I summarize the unclassified proceedings and discuss related issues.

Operations Research Modeling

Papers dealt with using operations research (OR) modeling to enhance the weapons systems acquisition process. Ms. Julie Chu and Captain Larry Cannon, USA, Advanced Systems Concepts Office, Army Armament Research, Development and Engineering Center (ARDEC), discussed using combat simulation model CASTFOREM in evaluating the Army future heavy mortar system. The CASTFOREM has been found to be an excellent force-on-force high resolution model, replacing the older CARMONETTE model used for years at battalion and task-force level. By running this model with different blue indirect fire systems (e.g., 120mm mortars, 8-inch and 155mm SP howitzers, and 220mm MLRS) against a standard RED threat, the best mix was found.

Among heavy mortar options were M106 (mortars in an open chassis) versus M2 Bradley (turreted mortars). Munitions employed were either High Explosive (HE), Improved Conventional Munition (ICM), Fiber Optic Munitions (FOMP) or Terminal Guided Monitors (TGMP) ammunition. The finding was that best results occurred when 120mm mortars with "smart/competent" rounds were employed to do more of the killing on the battlefield, especially by engaging "hard" targets like tanks. This allows other indirect fire systems to operate more effectively by attacking other targets.

It was found that turreted mortars survived better than the M106; fire control enhancement improved the rate of fire, survivability and mobility (through faster "shoot and scoot"); and enhanced target acquisition significantly increased the benefit of such mortar systems. Future Army applications of CASTFOREM include a study on using hand-emplaced, wide-area mines to examine their battlefield effectiveness. Army representatives at this presentation were particularly heartened by the close-working relationship of the Army Materiel Command and the Training and Doctrine Command.

Missile Program Management

Also discussed was a simulation model to support high-level, decision-making in missile production systems. William L. Scheller, The Analytical Science Corporation, (TASC) presented a paper on this application. This model was developed in-house at TASC in response to the increasing complexity of missile program management. This trend has prompted development of improved automated support tools for program managers, in this case a missile production simulation model written in the SIMAN language.

The model is complete with all aspects of a production system including raw material arrival and inspection, various inventories, shop operations, assembly, quality control, etc. Simulation runs are provided on various lot options (e.g., a five-lot buy of 100 missiles, a four-lot buy of 125 missiles, etc.) to produce, ultimately, 500 missiles. Output attributes analyzed included scrap costs, mean finishing times, machine shop utilization and cost variation. The simulation model provided benefits, including a tool for performing good sensitivity analysis, accomplishing identification and analysis of the impact of major changes on the schedule, and identifying effects of important programmatic variables. The model was useful for examining the facility and determining a possible means of alleviating a bottleneck, thereby reducing the time to complete the program. Overall, the model highlighted that decisions become more objective by providing engineering insight into system behavior.

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The views herein are those of the author and do not purport to reflect the position of the United States Military Academy, Department of the Army, or the Department of Defense.

There was a presentation of a mixed integer linear programming model (Phoenix) to develop optimal Army material acquisition strategies. Major Robert D. Clemence, USA, Army Concept Analysis Agency (CAA), presented a paper on using this OR technique. The model's purpose was to develop a system acquisition strategy or plan to meet future requirements of certain classes of systems (mission fleets) by modernizing in echelons. These fleets include helicopters and trucks. This model seeks to replace aging and obsolete systems with an affordable mix of new systems and product improvements. The Phoenix mixed integer programming model provides an automated decision support tool for longer range acquisition planning to accomplish this purpose. The objective function is to minimize research, development, acquisition and ownership costs, and penalties for violating constraints on requirements (mission fleet size), resources (funding and production capacity), and policies (mission fleet average age, technology mix).

Decision Variables

The continuous decision variables are for each year: number of systems to be produced; number to be retired; number to be placed in a Service Life Extension Program (SLEP); and number to be transferred between force echelons (force packages). The integer decision variables are dummy 0-1 variables that indicate each year whether a production line is to be opened or closed. Constraints include considerations like the annual budget, annual force structure requirements, annual technology goals for each fleet,

and annual average age goals for each fleet. An example was the attack fleet helicopter. Outputs included the number of AH-1s, AH-64 and LHX-ATK helicopters to be procured by year during the 1989-2008 period.

A second example focused on light, medium and heavy truck fleets. The model had the characteristic of "smoothing out" buys of replacement helicopters while stabilizing overall fleet size. It is intended to extend this methodology and employ the Phoenix model in the modernization of seven other mission fleets in the Army.

Also discussed was a Tank Ammunition Combined Arms Resupply Model (TACARM) developed by Major K. Steven Collier and Major Ron McCandless at the Armor School, Fort Knox, Ky. This was needed to determine planning of armor system requirement and armor force structure. We heard that using conventional models (like CASTFOREM) and National Training Center (NTC) data results in attrition rates for armor that are considered unreasonably high. This is due to things like tanks being "laser brave" at the NTC. Thus, an alternative new scripted model was developed called TACARM, which is used in the analysis of acceptable risk for armor systems; e.g., is there enough ammunition to support the tanks in the battle? The TACARM works backward from outputs considered reasonable in terms of tank ammunition status, vehicular status and tactical dispositions. Using a Monte Carlo simulation, TACARM employs a deterministic method to reach desired results and stochastically allocates available resources. Inputs are stowed

loads of ammunition on board each tank, percent supply, red and blue kills, etc. A sensitivity analysis results when different stowed loads and probabilities of kill (PKs) are entered with resupply constraints. This model has helped assess design characteristics of the Army's future tank. It will be useful in providing a solid analytical basis to argue for different stowed loads of ammunition in a tank.

Operations Research Techniques And Analysis

Besides models, there were presentations focusing on OR techniques useful in the weapons systems acquisition process. An interesting one was "Application of Advanced Information Processing to the Weapons System Acquisition Process" by David J. Goerz of General Dynamics. His paper focused on specific techniques that can be used for various acquisition phases; i.e., concepts exploration, demonstration/validation (DEM/VAL), and full-scale development. The competitive environment in acquisition establishes the need for efficient, automated decision analysis tools to satisfy the unique modeling requirement existing at each stage of the development process. It was shown that in the concept exploration phase, typically "back-of-the-envelope" and rudimentary LOTUS models are used. As a program proceeds to the DEM/VAL phase, low-level gaming and expected value models are employed to do architecture definition, cost and system performance, and risk assessment. In the DEM/VAL phase, simulation starts to become important as Monte Carlo simulation is first employed, then deterministic modeling and, lastly, hardware-in-the-loop modeling.

Specifically, as more hardware prototypes are brought on-line, results of their operations are incorporated into simulations. As the system proceeds to full-scale development, "high fidelity modeling" is employed as the simulations incorporate more test data from actual flights. Each phase of the weapon systems acquisition process requires a different level of operations research modeling detail. Simulation is shown to be in demand and is extremely important due to complexity of modern-day battlefields and the increasingly competitive acquisition process.

Mr. Goerz calls for an increase in corporate investment for OR activities so that a company can make better funding decisions in an increasingly competitive environment. Other new methodologies he advocates include advanced mathematical algorithms, logic structures, software configuration management, graphics, and high-performance computer architectures. He sees networks theory as experiencing a major increase in interest within the operations research community. Such conventional techniques as minimum spanning trees, shortest path and capacitated flow algorithms provide efficient methods to manipulate large networks of nodes and the flow of information on the battlefield. These techniques are particularly applicable to information flow and C3I applications. Artificial Intelligence (AI) provides methodologies that are gaining increasing importance and finding more use in computer models. A standardized analysis of variance (ANOVA) program, developed by Dr. Genich Taguchi and cited by Mr. Goerz as gaining wider acceptance, minimizes the number of required trials in the design of factorial experiments.

Support T&E

Other techniques discussed support the operational test and evaluation conducted in the weapons systems acquisition process from system concept through fielding. Major Theodore J. Janosko, USA, Army TEXCOM Experimentation Center (TEC), Fort Ord, Calif., focused on two different tests: the Early User Test and Experimentation (EUTE); and the Force Development Test and Experimentation (FDTE). The EUTE often occurs during the proof-of-principle phase when only rudimentary prototype equipment is available. The FDTE occurs later with the objective of developing/certifying optimum training, tactics and doctrine for the employment of the system.

Both tests involve defining key criteria for evaluation and design of simple experiments to provide needed data. These experiments are often realistic battles when casualties are assessed by a computer operating as a high-speed umpire; weapons systems effectiveness, organizations, and tactics are examined in an environment closely simulating combat. At Fort Hunter Liggett, Calif., TEC maintains sophisticated instrumentation performing data gathering, control, reduction, and simulation functions. The OR and other scientific analysis are conducted on the data. The Army Advanced Anti-tank Weapon System, Medium (AAWS-M) EUTE, was conducted at Fort Ord and Fort Hunter Liggett in early 1988 to examine capabilities of three AAWS-M candidates when employed in offensive and defensive operations, including military operations in urban terrain (MOUT). Results were used to support a full-scale development decision. A Pedestal Mounted Stinger (PMS) PDTE was conducted at Fort Hunter Liggett in February 1989, producing data to allow analysis of operational concepts including training, tactics, and procedures critical to PMS use.

Major Tim Berquist, USAF, Air Force Systems Command, discussed "Tools, Techniques, and Data Bases in the WSA Process," highlighting that there were few tools, techniques, and data bases available to aid decision-makers with the manpower, personnel and training (MPT) requirements in the Weapons Systems Acquisition process. The MPT Technology Branch of the Air Force Human Resources Laboratory (AFHRL) has established a long-term research program to address these shortages. This branch will develop MPT technologies for forecasting new and modified weapon system requirements providing efficient weapon system fielding, and supporting MPT decisions for existing weapon systems. A subsequent MORS composite group meeting entitled "Manpower, Personnel, Training, and Safety (MPTS) in the Defense Weapons Systems Acquisition Process" focused attention on this neglected area. In December 1988, DOD Directive 5000.53 was issued and established new policy and reporting requirements affecting analysis of MPTS concerns early in the WSA process. The directive is specific in pointing out that operational effectiveness and suitability of new systems cannot be assessed without careful attention to MPTS issues. This poses a major challenge to the military OR community since this will affect a major change in the way new weapons systems are evaluated. There are many examples illustrating that human factors must be integrated in future WSA planning; e.g., SINCGARS and MILSTAR. It appears that MPTS factors will be heavily weighted by future Sources Selection Evaluation Boards. The Services will be contributing to an improvement in the DOD Total Quality Management (TQM) initiative.

Total Training

Dr. Judy O'Neal further emphasized MPTS in "The Acquisition of Total Training Systems as Subsystems of a

Weapon System Acquisition." She discussed the parallel nature of weapon systems and total training system acquisition and analysis; total training system-unique analytical requirements; integration of weapon system and training system requirements; and impact of training system acquisition and development trends on institutional and corporate management and organization. This presentation was lucid in a call for analysis to support the establishment of "complete training systems" in the WSA process, and better tools and techniques to eliminate redundancies now existing due to a lack of integration of current training systems and WSA.

Several presentations focused on developing new data bases to improve the WSA process. Edward C. Robinson of ANSER discussed "DOD Acquisition Regulatory Streamlining: An Interactive Relational Data Base Approach to Defense Enterprise Program (DEP) Analysis." The Defense Enterprise Program had evolved from Packard Commission recommendations. In these programs, the WSA process is significantly aided by streamlining reporting, eliminating "over-regulations," and increasing stability of funding. Mr. Robinson discussed an automated interactive relational data base that ANSER developed to facilitate real-time identification review, analysis and categorization of many existing regulatory documents.

The use of analysis in the WSA process, discussed by Bernard H. Rudwick, Defense Systems Management College, was entitled "Could Cost Analysis: What Is It? How Should It Be Done?" Could Cost is a methodology that DOD hopes will provide substantial reductions in the cost of developing and producing weapons systems. All Services were asked to initiate a demonstration project using "could cost." The Army chose the Bradley Fighting Vehicle;

Navy, Trident D-5 Missile Program; Air Force, B-2 Advanced Technology Bomber. Mr. Rudwick became involved with this initiative when the College assisted McDonnell Douglas and the Army Aviation Systems Command (AVSCOM) in performing a Could Cost analysis of the eighth production buy of the Apache Helicopter. See Mr. Rudwick's article in the January-February 1989 *Program Manager*.

The Navy Office of Naval Technology was represented, as was BK Dynamics, Inc. Robert P. Moore presented the "Automated (PC Based) Technology Transition Planning System," which is new and helps provide an integrated view of research and development needed in acquisition environment. This system is valuable in tackling a vexing WSA problem; that is, the best way to identify and infuse advanced technology into new weapons systems. A data base has been constructed to identify and assess the maturity of available technologies. For example, if a new program contemplates using focal plane arrays, it can consult this system.

David Shaffer, Army Materiel Command System Analytical Agency (USAMSAA), reviewed analysis conducted on adequacy of the Initial Provisioning Packages, which are established for major systems before fielding. This analysis raised concerns about the current stockage policy that relies on demand data to support PLL/ASL stocks. Analyses, done on three systems (Apache helicopter, M1A1 tank and M2A1/M3A1 Bradley) clearly showed that a new "sparing-to-availability" system appears preferable to the old demand based supply system. The new system uses optimization techniques to stock spare parts to meet availability targets. The analysis further showed major cost savings can be achieved by adopting this new system.

"Applying Optional Subset Selection to Procurement and Acquisitions for the Armed Forces," presented by Dr. Chaim M. Ehrman, Loyola University, Chicago, focused on a two-stage procurement process where certain prospective contractors are eliminated in the first stage after proposals are evaluated as deficient. Dr. Ehrman argued there is merit in employing statistics to identify "false negatives"; i.e., contractors perceived as being non-responsive or unworthy when, in fact, that contractor would be good. His method employed using variance and Z-scores to identify such contractors.

Summary

The MORS Working Group on Weapons Systems Acquisition affords the weapons systems community an excellent opportunity to review OR models, techniques and other analysis being used by the Services. It allows the OR community to assess emerging needs of the WSA community. Operations research is a dynamic sub-discipline of engineering that is experiencing growth and increased importance. Decision-makers are increasingly relying on OR quantitative techniques to improve their decision-making. A review of 1989 MORS Symposium papers reinforces this perspective.

The next MORS Symposium will be in June 1990 at Annapolis, Md. Ms. Joanne Langston, occupant of the Army Chair at the Defense Systems Management College, will be the new Working Group Chair. If you want to present a paper, propose another forum (seminar or panel), or assist in any way, please contact Ms. Langston or the author: Ms. Langston, Commercial (703) 664-5979, or Colonel Arbogast, (202) 746-3642. This MORS working group has the potential to be a major asset to the WSA community.

WHY OFFSETS?

Lieutenant Colonel Robert L. Waller, USAF

In recent years, offset agreements have accompanied many major defense sales to foreign governments. In fact, offsets have become so ingrained in sales involving aerospace and electronic equipment that many firms established separate units or divisions to satisfy their offset obligations. (As an example, McDonnell Douglas established its International Business Center within its St. Louis headquarters with a staff dedicated to fulfilling offset commitments.) Since program management personnel involved with foreign military sales efforts will likely encounter offset arrangements between the defense supplier and the foreign government, it would be useful to understand the economic motives behind these agreements.

First, what exactly are offsets? Often discussed with the more general term countertrade (which includes international transactions like counterpurchases, buy-backs, and even barter), offset agreements between buying government and defense equipment producer involve the seller's commitment to make reciprocal purchases (counterpurchases) from, or investments in, the buyer's country. This agreement is normally made in conjunction with the actual sales contract itself and often is a key consideration in the buyer's selection of the winning bid.

In general, offset agreements involve actions by the seller to compensate the buyer for the economic impact on the buying country from purchasing a costly foreign-made product. These agreements may be associated with purchases of large capital-equipment items and civilian aircraft, as well as defense equipment. The economic impact that the buyer wishes to have offset normally includes loss of domestic employment and production opportunities, and loss of foreign reserve holdings. Offset agreements may involve coproduction, licensing, subcontracting to local firms, counterpurchases from local suppliers, capital investments, export sales assistance, and promotion of tourism.

A hypothetical defense equipment purchase involving offsets might develop like this. Government officials in country P, recognizing the need for a new defense item and lack of domestic industrial capacity to produce it, approach potential foreign suppliers for proposals to build the item. Since the defense item is costly, officials in P inform foreign suppliers that offsets, equal to a percentage of item cost, will be expected.

A U.S. firm, S, bidding for the contract to supply the item, first attempts to convince officials in P that its product (the defense item) is superior to that offered by competitors. To comply with P's offset requirements, S designs an offset package it feels will be attractive to P. The offset package will most likely consist of purchases by S and its subcontractors from firms in P. These purchases may be components for use in manufacturing the defense item, or they may be unrelated goods and supplies for use in other production activities. In addition, S may offer to make certain investments in P, to transfer specific technologies to firms in P, to assist in marketing P's goods in third countries, and to promote increased tourism in P.

After P receives proposals pertaining to equipment and offsets from S and other potential suppliers, P selects the winning producer. P's choice will be based on the defense item's cost and performance, and the benefits projected to result from the proposed offset package. Producing and delivering equipment may take 5-10 years, while fulfilling offset obligations may take longer.

With this understanding of what constitutes a typical offset agreement, let's discuss economic motives leading countries to request offsets. Why would they choose this type of transaction when a simpler, more straightforward cash deal is available and might result in a cheaper price for the desired item? The assumption here is the buying nation has two choices: to buy the item with no strings attached—a straight cash deal—or buy the item with accompanying offset deal, but more than likely paying a higher item price to get the offset agreement. In the following discussion, I'll go beyond media reports of the occurrences of offsets for a better understanding of the buying government's economic motives.

In general, economic motives for our allies'/customers' offset demands can be broken into seven broad, sometimes overlapping, categories. These are to increase the use of labor, increase investment (capital formation), gain marketing and production information, support key domestic industries, win support for certain "strategic" purchases, reduce risk and uncertainty, and provide an alternative form of financing.

In economists' jargon, an offset agreement appears to be a blunt instrument of commercial policy—an alternative to using tools like tariffs and direct subsidies by the offset-requesting nation. In fact, in many cases these industrial benefits or industry participation programs as they are often called, seem to be no more than disguised subsidies. The effect from the offset agreement could be obtained more efficiently using a direct subsidy; however, domestic political barriers may exist that bar a direct, and more visible, subsidy. Instead, the country chooses to pay more for the foreign-made item to get the offset package, which provides desired economic benefits. That is, the offset package is actually a concealed, indirect subsidy. I will now discuss each of seven motives I listed.

Labor Market

A country may have many unemployed workers, or a significant percentage of its work force in low-skilled industries. Either situation may justify government action. Some form of stimulative macroeconomic policy or reduction in the minimum wage might be helpful in the first situation; a direct subsidy to employers with workers in certain skilled fields might be the most direct way to attack the second. An offset agreement is another option available to a foreign government wishing to stimulate its domestic employment, in general or in selected fields.

The government can use an offset agreement to require the selling firm to agree to certain coproduction and subcontracting arrangements. These direct that a portion of the production effort be accomplished in the local economy. In particular, certain components or tasks for advanced-technology aerospace and electronics projects would be produced in, or performed by, local industries. These offset provisions should increase domestic employment, particularly in selected skills, since

without offset requirements these portions of projects would probably be produced in the seller's country.

In economic theory, government intervention, through offset requirements, helps correct a distortion in the labor market.

In the first case, perhaps it was the existence of rigid wages that prevented the economy from achieving full employment, and the increased demand for labor helped the economy move toward that desired condition.

In the second case, the government may have recognized certain labor skills would enhance the country's competitiveness; therefore, highly skilled workers have a social value greater than their private value. Here, the offset agreement has corrected for the existence of an externality or spillover effect (from the national perspective).

Capital Investment

Another motivation for requiring offsets would be a government desire to increase capital investment within its country. Decision-makers may perceive that acquiring certain capital-equipment and gaining modern industrial capacity provide the opportunity to improve the labor-force skill level and enhance the nation's self-esteem and standing in the world community. Since newly acquired capital has, therefore, a social value in excess of its private cost, government intervention is justified. Without government involvement, the investment level would be too little because private agents, responding only to private benefits and costs, will invest less than the social optimum.

To increase investment to the socially desirable level, the most efficient economic policy is for government to subsidize firms' investment activities. However, such a subsidy scheme, with payments going to firms undertaking new capital projects, might prove politically unpopular due to resistance from other firms feeling "left out" and from workers.

As an alternative to the direct subsidization scheme, the government may turn to offsets to promote investment in the country. By using an off-

set agreement on, say, a large defense purchase, the government can stipulate that the selling firm must invest some of its revenues from the sale in the purchasing country. The investment requirement most likely will stipulate that the selling firm provide some demand for the output from the new investment, or at least some assistance in marketing it—thus ensuring project viability for a time at least. In so doing, the government can use its market power as a purchaser to win the desired increased investment while avoiding the political sensitivity of a direct subsidy scheme, thus making the subsidy effect less visible.

Because the seller in such an agreement would be expected to increase its price to recover added costs from the mandated investment, the offset agreement again appears to be no more than a subsidy scheme. The government pays the higher price for goods to get the investment specified in the offset agreement.

Information

A third desire leading to a country's demand for offsets is to gain valuable information. The government can stipulate in its offset agreement with a foreign defense supplier that the supplier must share its marketing information and expertise with less-experienced and relatively unknown domestic firms; this could win sales in previously uncharted foreign markets. Government action is needed, first, to reduce transaction costs over those that would be incurred if each firm sought marketing assistance individually; second, to capture the social value of information and initial sales. The social value of initial sales and marketing experience obtained through the offset agreement exceeds its private value since the experience and reputation gained will aid other domestic firms in winning future sales.

Another example of how a desire for information can lead to offset agreements involves government efforts to obtain the latest technologies for domestic industries. In offset agreements, governments may require that foreign suppliers transfer to local firms certain advanced production technologies, which would enable

domestic firms to improve productivity and become more competitive, diversify outputs and, perhaps, gain some self-sufficiency.

Economic theory would show that using offsets to gain desired marketing and production information is a response to the fact that information has an externality; i.e., information benefits the nation as a whole and not an individual firm.

Key Domestic Industries

A fourth motivation for demanding offsets, related to the quest for technology, is to promote certain domestic industries within the buyer's country. Very often, for national security and political independence reasons, chosen industries are producers of defense equipment. While the best economic instrument to achieve this objective is a direct subsidy to targeted industries, such a policy may not be available for political reasons; i.e., controversy that would likely accompany direct subsidies to defense firms. Therefore, an offset agreement, also less visible, could serve as a second-best instrument.

Government use of offset agreements could achieve the objective while offering political advantages. In an offset agreement associated with purchasing defense items from a foreign supplier, the government can use its market position as a buyer to require either that the supplier allow coproduction or that it must place a certain percentage of the applicable subcontracts with local defense firms. While the offset would gain the desired defense work for domestic firms, it would make the subsidy to those firms less visible, possibly more acceptable from a political perspective. To the extent that both the defense industry promotion and the foreign defense purchase were controversial political issues, the two could be "packaged" together to avoid two separate national debates, and to use the economic stimulus and employment benefits to dampen domestic controversy.

Strategic Purchases

In an argument similar to the industry support scenario, a government may use an offset agreement to win

domestic support for a decision to purchase a costly foreign-made defense item. Expecting resistance from legislative members, other ministries and taxpayers in general, defense officials may require the foreign supplier to agree to counterpurchase, coproduction, and other offset arrangements so that the domestic economy is seen as sharing in the benefits generated by the defense purchase. Therefore, the required domestic political support is obtained by "packaging" the defense purchase with the employment and production opportunities.

To the extent that offset requirements do, in fact, generate enough domestic stimulus to offset some cost of defense equipment, the government will have used its market power as a buyer to win effective cost reduction while achieving desired political support. On the other hand, if offset stimulus is minimal, and counterpurchases and coproduction would have occurred anyway, no true cost reduction will be enjoyed. Instead, the government only uses the offset agreement to create "smoke" by "packaging" the purchase with perceived additional benefits; this allows it to procure something which, in its eyes, has social value greater than value perceived by private agents.

Risk and Uncertainty

Another motive for a request for offsets, closely linked to the desire to increase investment, is the buying country's wish to reduce risk and uncertainty. The risk involved with designing, building and starting-up a new production facility and the uncertainty of markets for its output can be lessened by offset agreements.

If the item purchased is the production facility itself (a chemical plant built by a foreign construction firm), the agreement may call for the foreign builder (selling firm) to buy back some resulting output. This assures the buying government that an export market for the output already exists, and it may encourage additional interest by the builder (seller) in the quality of the resulting output and in finding a prompt solution to production problems.

If, instead, the plant is already built and the government is buying unrelated items from a foreign supplier (defense equipment), the government can request the offset agreement (associated with the defense sale) include counter purchases of, or marketing assistance for, the plant's output. This would reduce the risk associated with finding markets for the fledgling production facility and would help ensure the project's success.

Financing

Final incentive for a nation's request for offsets is to use them as an alternative source of financing. A country in need of costly foreign-made items and facing an imbalance in its trade account may wish to avoid worsening its trade deficit. An offset agreement that calls for the seller to purchase, or find buyers for, an equal monetary value of goods and services from the buying country would enable the buyer to import desired items without a net loss of foreign reserves.

Summary

Offsets may be requested by our Allies in conjunction with their defense purchases from us for many reasons: to increase the use of their labor, increase investment activities in their countries, obtain marketing assistance and technology, promote targeted domestic industries, gain political support for their purchases from us, reduce risk and uncertainty associated with large production facilities, and finance imported goods without worsening trade imbalances.

In some of the scenarios discussed, it appears the objective sought by the offset-requesting nations could be obtained more directly with a straightforward subsidy scheme; however, domestic political constraints may preclude using direct subsidies. Therefore, governments use offset arrangements as indirect and less visible methods of achieving desired objectives.

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